

SELF-PERCEPTION OF AFFECT EXPRESSION

by

M. ERIN BROWNE

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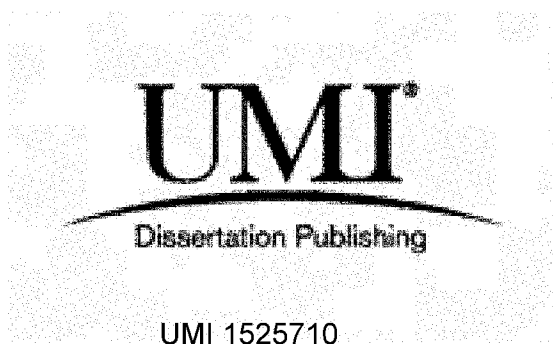
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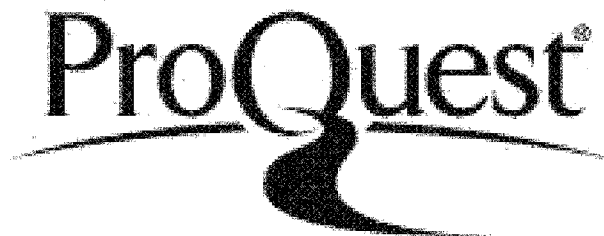
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Abstract

Definitions of alexithymia rest upon the assumption that the trait is characterized by deficits in emotional processing; though impaired perception of one's own emotion is considered a core feature of alexithymia, empirical investigation of this deficit is lacking. Additionally, the impact of alexithymia on pain experience, perception and expression has not been well investigated. In this study, participants were covertly videotaped as they rated their feelings during a cold pressor task and an emotional slide-viewing task. In a second session, participants viewed clips of their faces expressing emotion and pain, and made a second set of ratings to determine perceptual accuracy. Results indicate that: while participants are accurate in rating their own facial expressions of emotion and of pain, high scores on components of alexithymia are associated with specific deficits in self-perception of negative emotion, a tendency to rate self-perceived negative emotion as less negative, and increased subjective pain intensity.

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Introduction

As with many constructs in psychology, a concise and agreed-upon definition of alexithymia has proven elusive. Introduced by Sifneos (1973) to describe a set of symptoms involving disordered emotion, the term is derived from Greek, meaning no words ('a' and 'lexis') for emotion ('thymos'). Initial theories of alexithymia were formulated of diverse criteria including constricted emotional functioning, poverty of fantasy life, and, fittingly, an inability to find appropriate words to describe emotions (Sifneos, 1973). The definition has since evolved into a more measurable and concise cluster of traits, no longer including measurement of features originally considered central to the characteristic, such as fantasy life and global emotional functioning (Taylor, 1984). Current conceptualizations of alexithymia include several distinct and quantifiable difficulties perceiving, describing and expressing emotion, comprising an overall deficit in the symbolization, processing and regulation of one's own emotions and the emotions of others (Wagner & Lee, 2008). Specifically, in most of the current literature these traits are thought to include and are operationalized as: difficulty identifying feelings, difficulty describing feelings, and a tendency toward externally-oriented thinking (as in the Toronto Alexithymia Scale, the most widely used measure of alexithymia in the literature) (Parker, Bagby, Taylor, Endler & Schmitz, 1993; Meganck, Vanheule & Desmet, 2008).

The exact composition of this collection of traits has yet to be agreed upon, with some definitions relying on an expressive deficit (both verbal and nonverbal) and others focusing on an inability to judge others' affective state. Indeed, some definitions of alexithymia are so broad as to use the terms "difficulties processing emotion" (as cited in Prkachin, Casey & Prkachin, 2009, p. 412), inability to "identify, understand or describe

[one's] own emotions" (Moriguchi, Decety, Ohnishi, Maeda, Mori, Nemoto, Matsuda & Komaki, 2007, p. 2223) and difficulty with emotional self-regulation (Larsen, Brand, Bermond & Hijman, 2003). Studies attempting to tease out the exact pattern of deficits in alexithymia have explored several avenues of emotional perception and expression with varying levels of success, with one prominent exception. While expressive deficits and the perception of others' emotion have been investigated, one of the fundamental tenets of the modern definition of alexithymia – a deficit in the ability to perceive and identify one's own emotional state – has been almost entirely disregarded. Previous findings clearly indicate that individuals with alexithymia exhibit an impaired ability to perceive and discriminate between facial expressions of emotion (FEE) in others, and that these individuals also have difficulty both in describing and in expressing their own emotions, as discussed in the following review of the literature. However, it remains unknown whether the latter issue stems from a true perceptual deficit in the registration of one's own feelings and the intensity of those feelings, or whether it is a solely communicative problem.

Expressive Deficits

Individuals with alexithymia exhibit specific difficulty with nonverbal emotional expression, as established in an investigation of expression and perception of facial emotion in alexithymia (McDonald & Prkachin, 1990). This study demonstrated that though alexithymics were similar to controls in their ability to judge prototypic displays of emotion, they were less adept at expression of emotions. Alexithymics were, with two notable exceptions, comparable to controls in the ability to express emotions. These exceptions were in the ability to pose anger and happiness facially, and in the ability to

spontaneously display negative affect (McDonald & Prkachin, 1990). This supports the idea that deficits in nonverbal expression are central to alexithymia, and has been further supported in a study of nonverbal communication during psychiatric interviews, in which participants with higher scores on the Toronto Alexithymia Scale (TAS-20) were less nonverbally expressive (Troisi, Chiaie, Russo, Russo, Mosco & Pasini, 1996). When video from dyadic therapy sessions was analyzed, patients with high alexithymia scores consistently show less aggressive facial affect (as defined by Facial Action Coding System – FACS-Measurement; Ekman & Friesen, 1978) than those with low alexithymia scores, supporting the theory that alexithymia is a disorder of affect regulation and expression (Rasting, Brosig, & Beutel, 2005). Moreover, individuals with alexithymia have been found to exhibit lower cognitive/experiential level emotional response to emotionally loaded videos, while at the same time showing higher physiological arousal as measured by heart rate (Luminet, Rime, Bagby & Taylor, 2004). From the perspective of these findings, alexithymia appears to be a problem not with the perception of or intuitive response to emotionally loaded stimuli, but with the expression of that response (Luminet et al., 2004). These findings, taken together, imply the presence of an inverse relationship between nonverbal behavior and alexithymia, and perhaps a particular inability to communicate negative emotion (Wagner & Lee, 2008).

Perceptual Deficits – Emotion in Others

To investigate whether difficulties characteristic of alexithymia stem from a disturbance in perception of emotion, a study assessing the ability of individuals with alexithymia to detect and to rate the intensity of several FEE in others was undertaken (Prkachin, Casey & Prkachin, 2009). Compared to non-alexithymics, university students

identified as alexithymic using the 20-item Toronto Alexithymia Scale (TAS-20) exhibited deficits in detection of anger, sadness, and fear when viewing static, posed facial expressions. Contrary to expectation, however, these individuals did not exhibit a similar detection deficit when viewing expressions of happiness, disgust or surprise (Prkachin, Casey & Prkachin, 2009). A follow-up study investigating whether these deficits in processing are a function of challenging temporal conditions found that when given unlimited time to view and classify the same expressions, alexithymics showed no difference in accuracy from their non-alexithymic counterparts (Prkachin et al., 2009). They did, however, display a difference in ratings of intensity of FEE, rating the intensity of each expression as lower than non-alexithymics did, especially in the case of fear. These findings suggest that individuals with alexithymia are less accurate than non-alexithymics in the detection of emotion in others, particularly with respect to negative, and/or potentially threatening emotions (Prkachin et al., 2009).

Perceptual Deficits – Emotion in Self

As previously discussed, it has been extensively reported that recognition and discrimination of facial expression of emotion in others is disturbed in individuals with alexithymia (McDonald & Prkachin, 1990; Simon, Craig, Miltner & Rainville, 2006; Louth, 1998; Simon, Craig, Gosselin, Belin & Rainville, 2008; Green, Tripp, Sullivan & Davidson, 2009; Gonzalez-Roldan, Martinez-Jauand, Munoz-Garcia, Sitges, Cifre & Montoya, 2011; Lane, Sechrest, Reidel, Weldon, Kaszniak & Schwartz, 1996). It has not been investigated, however, whether a similar deficit exists with regard to perception of one's own facial expressions of emotion. This is surprising, as a person's emotional experience is principally communicated nonverbally via facial expression, and therefore

the internal representation of emotional experience is likely to be dependent on one's own facial expression (Hang Li & Tottenham, 2011). Indeed, research indicates that high judgmental accuracy in thin-slicing facial expression ("thin slicing" refers to evaluating facial emotion in very brief recordings of behaviour) is due to "implicit knowledge of mental representations of exemplars" in the category being judged (Smith & Zarate, 1992; as cited in Ambady, Bernieri and Richeson, 2000, p. 254.). The most direct test of whether a person is able to perceive their own emotion, therefore, ought to use this salient internal representation: their own face expressing emotion.

Relation to Pain Expression and Perception

Research supports the existence of a relationship between alexithymia and the perception and experience of pain. The nature of this relationship is unclear, as conflicting findings are present in the literature. However, as patients often develop alexithymia in the context of chronic pain and injury (Hosoi, Molton, Jensen, Ehde, Amtmann, O'Brien, Arimura & Kubo, 2010; Lumley, Radcliffe, Macklem, Mosley-Williams, Leisen, Huffman, D'Souza, Gillis, Meyer, Kraft & Rapport, 2005; Wood, Maclean & Pallister, 2011), it stands to reason that difficulties perceiving and expressing pain might present with similar patterns.

Similarly, given the findings reviewed above suggesting that alexithymics have particular difficulty perceiving and expressing negative emotions (McDonald & Prkachin, 1990; Wagner & Lee, 2008), it is reasonable to expect that pain expression and perception should also be affected. A study of induced physiological stress via a hand grip task supports the notion that alexithymics have an expressive deficit with regard to unpleasant physical sensation, as alexithymic participants reported feeling increased

physiological stress but did not facially express this physical discomfort (Naatanen, Ryyanen & Keltikangas-Jarvinen, 1999). Certain facets of alexithymia have also been associated with less negative assessments of emotionally laden videos (such as a cancer patient discussing her experience of terminal illness) (Luminet et al., 2004), a finding that echoes Vanman et al.'s (1998) discovery that the presence of alexithymia moderates emotional valence ratings of negative affect-laden slides taken from the International Affective Picture System (IAPS; Lang, Bradley & Cuthbert, 2005), a widely-used method for eliciting emotion that makes use of photographs scaled for degree of emotional arousal and pleasantness-unpleasantness.

Nyklicek and Vingerhoets (2000) found that individuals with high alexithymia scores had lower pain thresholds than those with low scores, indicating a qualitative difference in response to emotionally evocative, non-visual stimulation. Low pain threshold correlated with high scores on TAS-20 subscales measuring externally oriented thinking and difficulty identifying feelings, with associations between global measures of alexithymia and both internal unpleasant sensations and externally induced pain (Nyklicek & Vingerhoets, 2000). This general hypersensitivity to unpleasant stimuli and amplified somatization in alexithymics has been supported by testing of alexithymic vs. non-alexithymic experience of visceral stimulation (Kano, Hamaguchi, Itoh, Yanai & Fukudo, 2007), and with testing of alexithymic vs. non-alexithymic experience of a cold pressor test, with difficulty identifying feelings accounting for the greatest variance in pain scores (Wood, Maclean & Pallister, 2011). Similarly heightened pain intensity ratings in alexithymic individuals have been found using a heat pain intensity test (Katz, Martin, Pag, & Calleri, 2009), though in another study individuals with alexithymia did

not show a general hypersensitivity to a cold pressor stimulus (Jackson, Nagasaka, Fritch & Gunderson, 2002).

As described above, the exact relationship between pain perception and expression and the presence of alexithymia is not clear. While several studies support the notion that alexithymics have a heightened pain experience and are less expressive of their pain than non-alexithymics, the literature is not definitive on these points.

Furthermore, research has not looked into whether alexithymic individuals exhibit a deficit in perception of pain via facial expression, either in themselves or in others. I expect that as “pain is perceived as more arousing and more unpleasant” than negative emotion, these effects may be easier to test for than emotional expression and perception in alexithymic samples (Simon, Craig, Gosselin, Belin & Rainville, 2008, p. 55).

Summary

The current definition of alexithymia characterizes the problem as a composite deficit in symbolizing, processing and communicating one’s own emotions and the emotions of others (Wagner & Lee, 2008). For the most part, this definition is supported by the literature. Individuals with alexithymia do exhibit impaired symbolization and processing of FEE in others, particularly with respect to the perception of others’ negative emotion (Prkachin et al., 2009). It also appears that the inclusion of expressive deficits in the definition is appropriate, as research suggests an inverse relationship between alexithymia and expressive behaviour, in particular regarding negative emotion (Wagner & Lee, 2008).

A portion of this definition remains unsupported, however: whether individuals with alexithymia actually have difficulty with the symbolization and perception of their

own emotion. In addition, the relationship between pain perception and expression and the presence of alexithymia is unclear. While it seems that alexithymics have a heightened pain experience as well as a nonverbal expressive deficit regarding their pain compared to non-alexithymics, it is unknown whether this is due to an issue with self-perception, as discussed above. This study addresses each of these unanswered questions using the judgment of one's own facial expression as a test of accuracy in self-perception.

Research Question

Alexithymia research ought not continue under the assumption that the current, partially supported definition is comprehensive and accurate (Larsen et al., 2003). As has been acknowledged in the scientific community, “fundamental assumptions about the alexithymia construct remain to be validated” (Lane, Sechrest, Reidel, Weldon, Kaszniak & Schwartz, 1996, p. 203). Such assumptions include the somewhat contradictory notions that alexithymia is at once an impaired symbolic representation of emotion (and thus a primarily linguistic or expressive deficit), and also a function of impaired ability to perceive and understand emotion. As it is not possible to label or communicate what one is unable to perceive or discriminate, these assumptions cannot necessarily be accepted in conjunction. I posit that alexithymia is a primarily perceptual deficit that arises as a consequence of an inability to perceive and conceptualize one's own emotion as an internal representation of emotional context and meaning.

In order to address what I see as an important gap in the existing literature on alexithymia, the present study focuses on the direct perception of one's own emotion and pain via facial expression. A study of this type has not been undertaken among alexithymics or controls, leaving an unanswered larger question: are people sensitive to

their own non-verbal expressions of their own emotions or pain? This question brings other uninvestigated issues into focus, such as *whether individual differences in the self-processing of FEE are correlated with alexithymia and, thus, whether a deficit in emotional self-recognition and understanding is in fact responsible for the difficulties inherent in alexithymia*. In effect, how is one to conceptualize another's emotional or pain expression if one cannot bring to mind a representation of one's own?

Researchers have used tests such as the Levels of Emotional Awareness Scale (Lane, Quinlan, Schwartz, Walker, & Zeitlin, 1990) to investigate perception of emotion via verbal labeling. The limitation inherent in this approach is that instead of measuring actual perception, this test measures availability and application of linguistic descriptions. I believe it will prove more efficacious to use visual analogue scales paired with FEE created by the individual him/herself to directly test self-perception of and discrimination between positive and negative FEE.

As it seems that alexithymics have specific difficulty with negative emotions - both in the expression of their own negative emotions and the perception of negative emotions in others - this study bypasses the finer shades of FEE in order to determine conclusively whether a deficit exists specifically for negative emotion expression and perception. Thus, instead of testing each emotional state in turn (e.g. happiness, fear, surprise, anger, etc.), this study tests positive vs. negative emotion broadly (i.e. pleasant vs. unpleasant). Also, a pain task (cold pressor) has been included in order to elucidate the presently unclear relationship between alexithymia and pain perception and expression.

Hypotheses

In order to resolve the aforementioned issues and elucidate the nature of the alexithymia construct with respect to experience and self-perception of pain and emotion, this study was conducted surrounding the following hypotheses:

1. People will be accurate in the self-perception of their own emotion via FEE.
2. Alexithymia will be associated with diminished accuracy in self-perception of emotion via FEE.
3. People will be accurate in perceiving their own pain via facial expression.
4. Alexithymia will be associated with diminished accuracy in self-perception of pain via facial expression.
5. Alexithymia will be associated with a heightened response bias with pain experience and self-observation.
6. Alexithymia will be associated with an emotional response bias, causing lower experienced and self-observed emotion ratings.

Method

Data for this study were collected as part of a larger project encompassing investigations of pain and emotion perception in self and others, as mediated by several variables (alexithymia, psychopathy, pain catastrophizing and empathy). Methods will be discussed in light of this collaborative data collection, but only information pertinent to the foci of this thesis will be reported upon here.

To investigate inquiries posed by this thesis, a basic two-component, two-phase study was performed. The first component involved collection of data representing people's subjective experience and behavioural responses to pain and emotional stimuli.

The second component involved collection of data representing people's perceptions of their own subjective experiences of pain and emotions, as evident in their initial pain- and emotion-related behavioural responses. Data for the first component of the study were collected in the first phase; data for the second component in the second phase.

Participants

One hundred ten participants were recruited from an undergraduate subject pool at the University of Northern British Columbia (UNBC) in exchange for course credit and a monetary incentive (\$15.00 at follow-up visit). The sample consisted of 51 males and 59 females ranging in age from 17-30 (mean = 20.2 years, SD = 2.46), predominantly Caucasian (70% Caucasian, 12.7% Multiple Ethnicity, 9.9% East Asian, 3.6% South Asian, 2.7% Other, 1.8% First Nations). 89% of participants were right-hand dominant, and all had normal or corrected vision. Participants were pre-screened for hypertension, but none were excluded on this basis.

Apparatus and Materials

Demographics

During the first laboratory session, each participant completed a short demographic form. Information solicited in this form included: name, telephone number, address, sex, age, ethnicity and manual dominance. Participants were told prior to form completion that provision of contact information was optional.

Audio Recorder

Spontaneous display of emotional facial expression can be reliably elicited through verbal description of one's emotional experience (Buck, 1979; North, Todorov & Osherson, 2012). In order to prompt participants to perceptibly emote (thereby ensuring a

detectable signal), a decoy audio recorder was placed in the testing room during the emotional expression task. This device was not operational; its sole purpose was to encourage participants to comply with researcher requests to describe their emotions aloud.

Assessment of alexithymia.

Toronto Alexithymia Scale

Alexithymia assessment was conducted using the 20-item TAS-20, the most widely used and psychometrically valid self-report measurement of alexithymia (Taylor, Bagby & Luminet, 2000; Meganck, Vanheule & Desmet, 2008). The TAS-20 is made up of three subscales: difficulty describing one's feelings (DDF; comprised of five items, such as "I find it hard to describe how I feel about people"), difficulty identifying feelings (DIF; comprised of seven items such as "I am often confused about what emotion I'm feeling"), and externally oriented thinking (EOT; comprised of eight items, such as "I prefer to analyze problems rather than just describe them"). Scores can fall in the range of 20-100, with a score of 61 or higher indicating alexithymia, and 51 or lower indicating no alexithymia; scores from 51-61 indicate probable alexithymia (Taylor, Bagby & Parker, 1997 as cited in Loas, Corcos, Stephan, Pellet, Bizouard, Venisse, Perez-Diaz, Guelfi, & Jeammet, 2001). Participants respond to each statement on a 5-point Likert scale indicating 'strongly disagree' to 'strongly agree' for each. The TAS-20 provides both individual scores on each subscale and a global score.

Measurements obtained using this scale were supplemented by use of a shortened form of the Levels of Emotional Awareness Scale (Lane, Quinlan, Schwartz, Walker, & Zeitlin, 1990) to ensure an accurate picture of deficits in emotional processing and

communication, as recommended following psychometric evaluation of the TAS-20 (Kooiman, Spinhoven & Trijsburg, 2002).

Levels of Emotional Awareness.

The Levels of Emotional Awareness Scale (LEAS) provides an assessment mechanism for emotional self-perception using verbal cues and labels. The original LEAS consists of 20 hypothetical scenarios that the participant is asked to read through and imagine him/herself experiencing. They are then asked to describe, in writing, how they would respond to the situation in real life. Each of the scenes receives a score of 0 to 5 corresponding to the cognitive-developmental theory of emotional awareness (Lane, Quinlan, Schwartz, Walker, & Zeitlin, 1990). Scoring is based on specific criteria measuring degree of differentiation in the use of emotion words and the differentiation of self from other, accomplished using a glossary of words for each situation. A score of 0 is assigned when non-affective words are used, or when the word 'feel' is used to describe a thought. A score of 1 is assigned when words indicating physiological cues are used in the description of feelings (e.g. "I'd feel tired"). A score of 2 is assigned when words are used that convey undifferentiated emotion (e.g. "I'd feel bad"), or when the word 'feel' is used to convey action (e.g. "I'd feel like punching the wall"). A score of 3 is assigned when one word conveying a typical, differentiated emotion is used (e.g., happy, sad, angry, etc.). A score of 5 is assigned to the total when the 'self' and 'other' rating each receive a minimum score of 4 and are differentiated from one another, so a maximum total LEAS score of 100 is possible.

The LEAS vignettes target four basic emotions (anger, fear, sadness, happiness) at five different levels of complexity, and are scored in order to determine the

appropriateness of each emotion as displayed by the participant. The LEAS has consistently been shown to have high inter-rater reliability, internal consistency, and test-retest reliability (Subic-Wrana, Beutel, Garfield, & Lane, 2011).

For the purposes of this study, the LEAS was shortened to facilitate online completion under a time constraint. Five questions were posed to participants, with space for 250-character responses after each (see Appendix 1). In light of this abbreviated version of the scale, the maximum possible score was 25.

Assessment of pain responses.

Pain responses were evaluated using self-report visual analogue scales and video data collected during a cold pressor task. Pain experience was generated and measured with the cold pressor task. Cold pressor stimulation was created with water maintained at a consistent temperature of 4°C in a circulating water bath. Participants were asked to immerse their non-dominant hand in the water for 3 minutes or until they felt they must withdraw it. As the experience of pain consists of both sensory and affective components (intensity and unpleasantness) that vary independently of one another (Price, Harkins, & Baker, 1987) and are differentially communicated via facial expression (Kunz, Lautenbacher, LeBlanc & Rainville, 2012), participants were asked to rate both components of their pain experience at various points throughout the task.

Ratings were made using visual analogue scales (horizontal lines with ends labeled “no pain” and “extremely strong pain” or “extremely unpleasant pain”), in order to avoid complications arising from verbal labeling. Each visual analogue scale (VAS) was presented on a 19-inch LCD screen, labeled appropriately (“intensity” or “unpleasantness”) and appeared as a 14.5 cm black, anchored line on a white background.

Presentation of all visual analogue scales during the study was randomized for each participant, controlled with a Dell Optiplex GX620 computer and programmed using SuperLab™ 4.5 stimulus presentation software (by Cedrus Corporation). Participants used a Logitech M705 wireless mouse to input their VAS ratings.

Facial expressions during the pain expression task were covertly recorded on video, using a Sony HD AVCHD Handycam (HDR-XR100) hidden from view by an arrangement of file boxes behind and to the left of the computer screen. The camera view was adjusted to focus through a small hole in one of the boxes, and zoomed to maximize the appearance of the face in the resulting recording. These recordings were later edited to create “thin slices” of pain expression over the course of the task using Sony Vegas Movie Studio 8.1. The same scales were used in the expression task and in the perception task in order to determine congruency and ability to perceive one’s own pain via facial expression. Much support has been gathered supporting the validity of visual analogue scales in pain measurement, demonstrating high sensitivity, reliability and positive relationships to other self-report measures as well as to observed pain behaviours using both pen/paper and computer-based scales (Jensen & Karoly, 2011).

Assessment of emotional responses.

Emotional responses were evaluated using self-report visual analogue scales and video recordings. To elicit spontaneous expressions of emotion, participants viewed 25 picture slides taken from the International Affective Picture System (IAPS; Lang & Bradley, 2007), which have been rated for and vary systematically as a function of arousal (referred to in this study as ‘intensity’ to facilitate participant understanding) and valence.

A representative subset of emotionally loaded picture stimuli was chosen for this study using normative rating information from the IAPS technical manual, in which 956 pictures and their respective average affect ratings are listed (Lang, Bradley, & Cuthbert, 2005). Slides were chosen based on mathematical criteria determining a range of stimuli distributed at equal intervals in ascending order of both intensity (from as low intensity to as high intensity as possible) and valence (from as negative to as positive as possible), both centering on a neutral rating. IAPS normed ratings range from a possible 1 (very low) to 9 (very high) on both affect dimensions; chosen stimuli for this study range in rating from 1.31 – 8.34 for valence, and from 1.76 – 7.34 for intensity (for IAPS ratings of all 25 stimuli used, see Appendix 3).

The affective dimensions of intensity and valence do not necessarily vary together, meaning that chosen stimuli include slides that may be any combination of intensity and valence (i.e., a slide may be high intensity and negatively valenced, low intensity and negatively valenced, etc.). Examples of negatively valenced slides used for stimuli in this study include a burn victim and a dental exam; examples of positively valenced slides include a happy elderly couple and three puppies. Examples of less intense slides include a pair of shoes and book; examples of more intense slides include an erotic couple and a man attacking a woman. As slides vary separately on these dimensions, some slides are low intensity and high positive valence (e.g. three smiling men at a wedding) some are high intensity and low valence (e.g. a dead man), and so on.

Slides were presented in random order for each participant. Participants rated the valence and intensity of each slide using two modified visual analogue scales (for intensity, a line with ends labeled “as weak as it could be” and “as strong as it could be,”

and for valence, “as unpleasant as it could be” and “as pleasant as it could be”) that appeared after each slide was presented. Each slide was presented for a total of 15 seconds. The same scales were used in the expression task (wherein the participants rated the intensity and valence of emotion created by each slide) and in the perception task (wherein the participants rated the intensity and valence of emotion perceived in their own videotaped facial expression).

Facial expression during the emotional expression task was covertly videotaped and edited to create thin slices corresponding to varying reported intensity and valence ratings.

Video editing.

Video was edited using Vegas Movie Studio to obtain a thin-slice of each emotional and pain expression at varying levels of intensity and valence. In all cases, audio was removed from the video file.

Completed pain videos for each participant included expression clips sampled from various points during the cold pressor task. Each expression clip lasted five seconds, and was taken from: five seconds preceding stimulation and the five seconds before each of 12 pain ratings. Participants who made 2 or fewer pain ratings due to early termination of the cold pressor task were excluded from the pain perception portion of the second visit ($n = 2$).

Completed emotion videos for each participant consisted of expression clips sampled from the videotaped and self-rated perception of each of 25 slides. Each 15 second expression clip comprised the five seconds spent viewing the slide and the ten

seconds spent verbally describing reactions to the slide.

Each participant, therefore, was shown two videos of him/herself in the role as observer. Presentation order of these videos was randomized. Digital display ceased for five minutes between the pain expression and emotion expression videos to allow for visual analogue scale changeover and reiteration of method. Each complete pain expression video lasted approximately 4.5 minutes (5 seconds for viewing each of approximately 13 pain expressions, and 20 seconds for judgment of those expressions). Each complete emotion expression video lasted approximately 15 minutes (15 seconds for viewing of each of 25 emotion expressions, and 20 seconds for judgment of those expressions).

Procedure

Recruitment of participants was accomplished using an online research participation system (SONA) in place at UNBC. This system provides an ideal platform for completion of pre-screen measures and booking of appointments. Participants completed the TAS-20 and short-form LEAS, questionnaires via SONA before their first laboratory session. They also made appointments for their first and second sessions via SONA, the second occurring a minimum of 4 days and a maximum of 10 days following the first.

This study consisted of two parts: first, an investigation of the relationship between alexithymia and people's perception of their own FEE, and secondly, an investigation of the relationship between alexithymia and participants' perception of their own facial expressions of pain. Participants presented at the laboratory on two occasions; first to complete the expressive portions of each experiment in order to gather video data,

and second to view and judge edited versions of collected video. On the first visit, they were given a detailed description of the study, though they were not informed that they were being videotaped during the pain (Part 1) and emotional (Part 2) expression segments in order to avoid social stoicism or altered expression. They provided both written and verbal informed consent before the experiment commenced. For each task, participants were seated in a quiet room at UNBC. Consent for use of the videotape was obtained at the end of the first visit, following debriefing. All participants consented to the use of their videotape for the purpose of this study.

First session – expression tasks.

Immediately after consenting to participation in the study, participants filled out a demographics information sheet. They were then asked to change into a shirt designed to allow access to the clavicle and lower left rib area, to facilitate psychophysiological recording associated with the collaborative aspect of this project. While the participant was out of the room, the video camera was turned on and hidden.

Upon the participant's return to the laboratory, a researcher attached the necessary psychophysiological recording equipment (three electrodes, one under each clavicle and one on the lower left rib, as well as a respiratory band). Participants were then read a scripted set of instructions (see Appendix 2), and a psychophysiological baseline measure was taken, lasting three minutes.

Pain task.

Following the baseline period, participants began the pain task. For the production of pain expression, participants immersed their non-dominant hand in the cold water for

up to three minutes. The water was held in a circulating water bath, and the temperature (4°C) kept constant within the commonly accepted standard for cold pressor use in adults – ranging from 0 to 7°C (Mitchell, McDonald & Brodie, 2004). Cued by an auditory signal controlled by the experimental software, participants rated the intensity and unpleasantness of their pain experience every 15 seconds using visual analogue scales, by manipulating a wireless mouse with their dominant hand.

Emotion task.

For the emotional expression task, participants remained seated in the same chair, approximately 80 cm from a computer monitor. A researcher read a scripted set of instructions (see Appendix 2), and then asked for permission to tape-record their verbal expressions of emotion (this was done using a decoy tape recorder; no audio recordings were made). Similar to Buck's slide-viewing technique participants viewed each slide for five seconds, after which an auditory cue sounded, signaling them to verbally describe their emotional response to the slide (Buck, 1974). After 10 seconds, the slide was no longer displayed, and participants were asked to report their impressions of the slide on each visual analogue scale of valence and arousal. After ratings were completed (maximum 20 seconds), the next slide appeared on the screen, and the procedure was repeated for all 25 slides.

Following the second task, participants were debriefed regarding the use of a hidden camera. Participants were rewarded with one bonus mark for their participating class following the first visit.

Second session – perception tasks.

Pain task.

Participants were seated in the same viewing area as in the initial visit, and briefed regarding the content of the video. They provided written informed consent, and were read a scripted set of instructions (see Appendix 2). Participants used the same visual analogue scales used in the pain expression task to record their judgment of the amount of pain they believed they were in for each thin-slice video clip. Each clip lasted five seconds, followed by a 10 second opportunity for completion of each visual analogue scale.

Emotion task.

In order to test self-perception and discrimination of intensity and valence of one's own emotional expressions, participants viewed the emotion segment of their respective video (in effect moving from the role of sender to the role of observer). They judged the intensity and valence of their emotional reaction using the same visual analogue scales as in the emotional expression task. Each clip lasted 15 seconds, followed by a 20 second blank screen to allow for visual analogue scale completion.

Data reduction.

Employing these methods, four data series (12 ratings each) were produced for the pain task and four (25 ratings each) for the emotion task, for each participant. For the pain task, each participant generated series of corresponding self-reported pain intensity, self-reported pain unpleasantness, self-observed pain intensity and self-observed pain unpleasantness ratings. Similarly, in the emotion task, each participant generated corresponding self-reported and self-observed emotional intensity ratings and self-

reported and self-observed emotional valence ratings. The degree of correspondence was measured using three indices of accuracy or sensitivity: individual participant correlations between Time 1 and Time 2 for each paired data series, individual participant slope values found by regressing the data series from Time 1 to Time 2 upon one another for each data stream, and individual percent accuracy.

Individual percent accuracy for emotion rating pairs was calculated by determining percent of matching self-report - self-observed ratings for each participant. In accordance with previous research and to avoid overly conservative cutoffs and missed information, a match was defined as existing when a participant's observed rating fell within plus or minus one point (or 10% of our 100 point VAS) of his/her sent rating (Iafrafi, 1986). Percentage accuracy was calculated by assessing the number of ratings made by the participant in the observer role that matched the ratings made by that same participant in the sender role, divided by the number of rating pairs made in total.

Any perceptual judgment task, in which observers are required to assign numbers to perceptual experiences, is influenced not only by factors such as accuracy or the ability to make distinctions between different levels of stimuli, but also by characteristics of the observer's judgment style, referred to as response-bias. In rating tasks such as those employed in the present study, response bias can be thought of as the tendency to locate ratings systematically at one or the other end of the rating scale. A characteristic way of evaluating response bias in magnitude estimation tasks - of which all the tasks in the present study are examples - is to locate the y-intercept of the regression line relating stimuli to responses. Therefore, in order to investigate whether alexithymia influences the overall tendency to apply higher or lower numbers when rating, response bias was

indexed by the intercepts of the regressions conducted on an individual level. The same reasoning was applied to sensitivity and bias in emotional responding, as well as pain experience and perception. Therefore, for each individual the slope and y -intercept describing relationships between self-reported and self-observed pain intensity and pain unpleasantness, emotional intensity and emotional valence was calculated using Excel.

Assumptions of normality were satisfied in that all data in this sufficiently large sample ($N = 110$) were normally distributed (as per examination of histograms, box-plots, skewness and kurtosis values), and no statistical outliers were present in the data.

Results

Figure 1 presents average *intensity* and *unpleasantness* ratings across the entire three minute pain task. The figure shows that both *intensity* and *unpleasantness* ratings increased in a linear fashion until approximately 90 seconds into the task, at which point pain ratings tended to level off and decrease.

Figure 2 presents average participant ratings of emotional *intensity* and *valence* over the course of the 25-slide emotional experience task, organized in order of stimulus magnitude (least pleasant to most pleasant and least intense to most intense, as determined by IAPS normed ratings). It can be seen that both *intensity* and *valence* ratings increased in a linear fashion over the duration of the task in a pattern that accorded quite well with the trend expected on the basis of the IAPS norms for selected stimuli. Stimulus slides chosen to generate emotional expression during Time 1 (subjective experience) were valid and effective, as evidenced by strong positive correlations between average participant self-report ratings of the individual slides and IAPS norms, both for *valence* of slides ($r = .966, p < .001$) and for *intensity* of slides ($r =$

.853, $p < .001$).

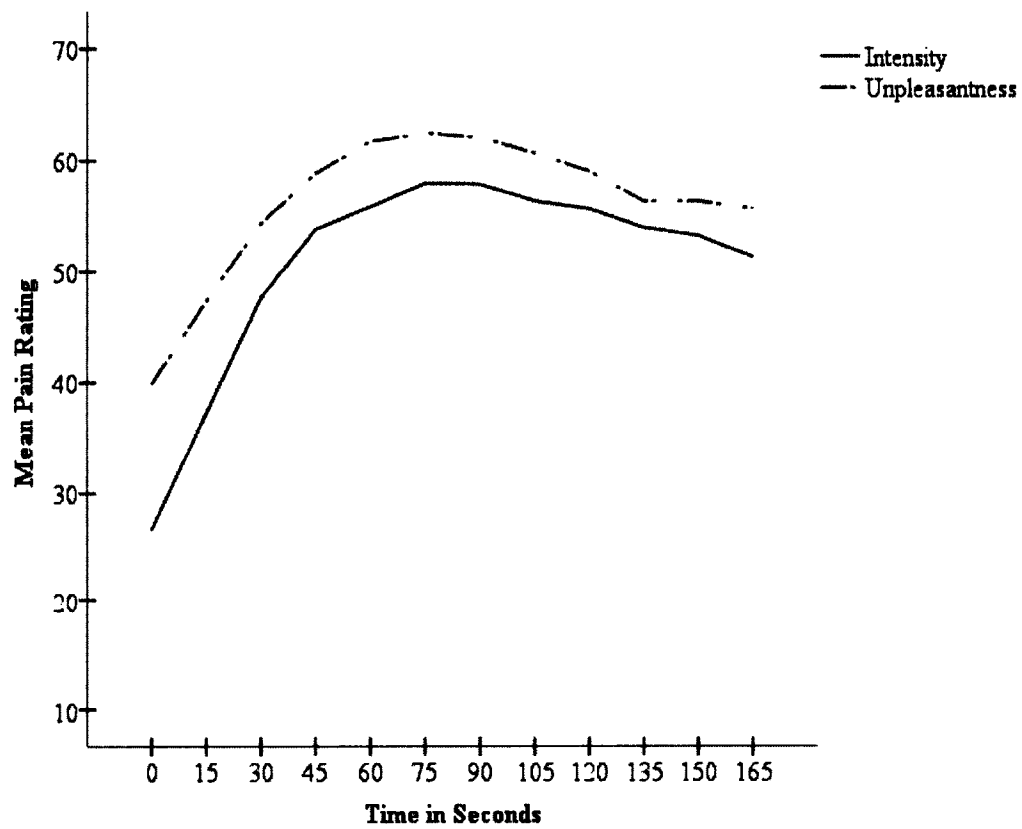


Figure 1. Mean intensity and unpleasantness ratings across all time points in cold pressor task.

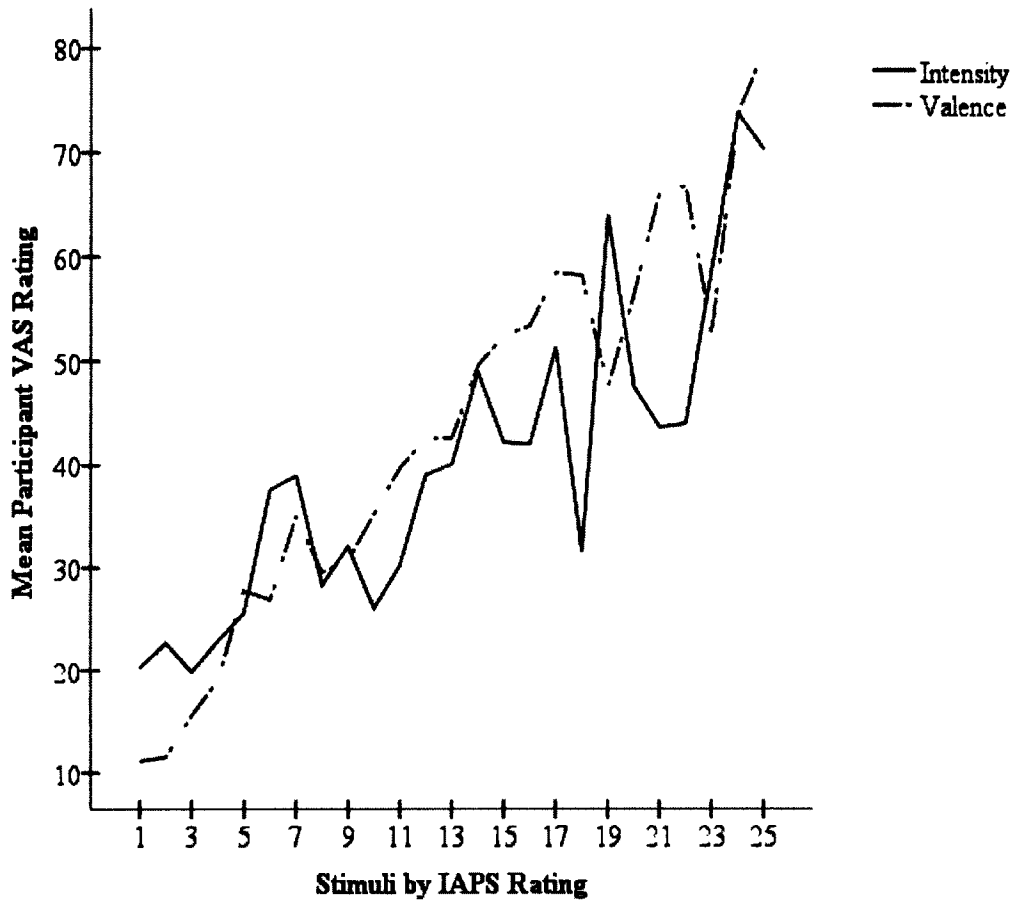


Figure 2. Mean participant ratings of intensity and valence across range of stimuli in subjective emotional experience task (T1).

Hypothesis 1. People will be accurate in perceiving their own emotions via FEE.

Accuracy in emotion perception can be evaluated at the aggregate level and at the individual level in the present data. Accuracy at the aggregate level refers to the correspondence between average T1 (subjective experience) and T2 (observed response) ratings at all stimulus levels, collapsed across participants. Figure 3 depicts average T1 and T2 ratings for the emotion task for *intensity*, where aggregate accuracy is indicated by parallelism of the lines. Average T1 and T2 ratings for *valence* produce a similar pattern. Accuracy at the individual level refers to the correspondence between T1 and T2 ratings for each individual participant. The measure of individual accuracy employed can

then be related to other predictor variables, such as measures of alexithymia.

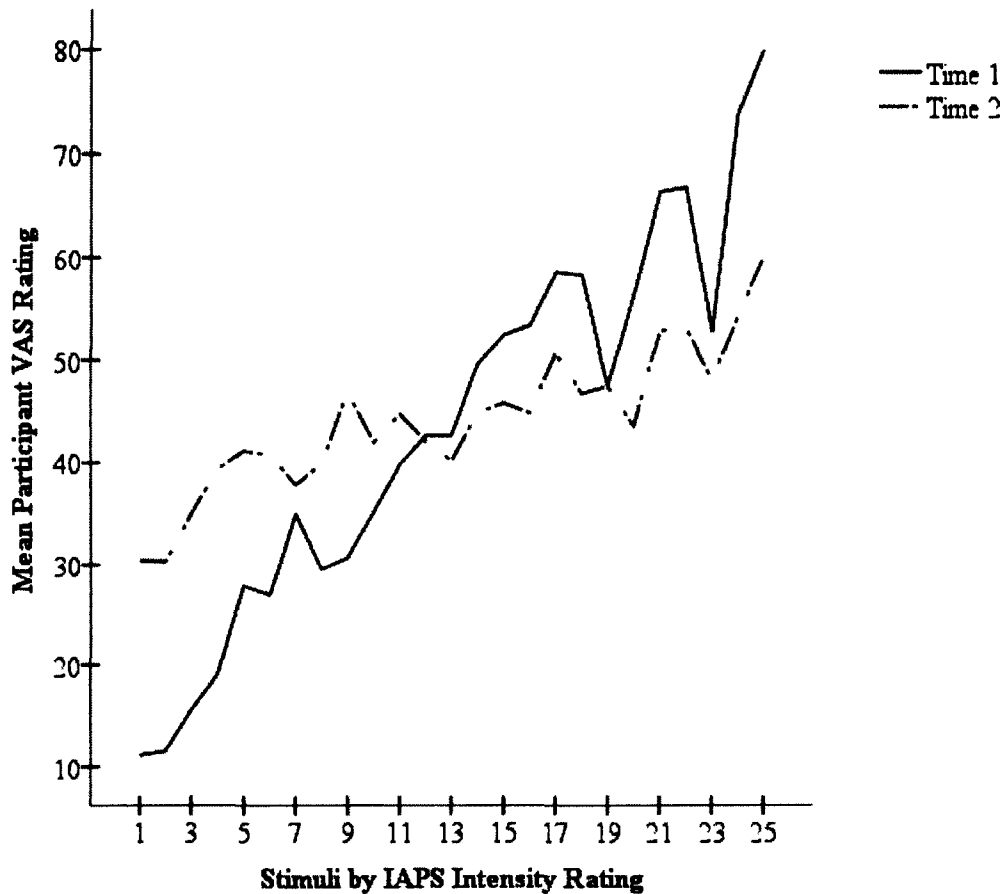


Figure 3. Correspondence of participant T1-T2 emotional intensity ratings.

For aggregate accuracy values, refer to Table 1. Presented therein are Pearson r correlations between average T1 and T2 ratings of emotional stimuli in general, as well as *valence*-specific correlations between average T1 and T2 ratings of emotional stimuli that are either positive or negative as indicated by IAPS norms. It can be seen that the T1 and T2 series show substantial parallelism overall for both *intensity* and *valence* ratings, as indicated by strong and highly statistically significant correlations. Thus, at the aggregate level, the data are consistent with the expectation, based on Hypothesis 1, that

participants would be accurate in perceiving their own emotions when observing their FEE.

Table 1
Aggregate Emotion Accuracy Indices

	Pearson <i>r</i> Correlation	
	Intensity	Valence
All Stimuli	.859**	.919**
Negative Stimuli	.869**	.806**
Positive Stimuli	.799**	.901**

* $p < .05$. ** $p < .01$.

Overall, then, the aggregate data were consistent with expectations based on Hypothesis 1: that people would be accurate in judging their own emotions when forced to rely purely on observation of their own facial expressions.

The accuracy with which people are able to judge their own emotions when forced to rely on their own expressions can also be evaluated at the individual level. Figure 4 shows the scatterplot relating each individual participant's average T1 and T2 ratings of their subjective experiences and observed emotional *intensity* ratings. The scatterplot shows a clearly linear relationship (R^2 Linear = .453). Thus, individual-level data support the conclusion that people are accurate in judging their own emotions by relying on their own facial expressions.

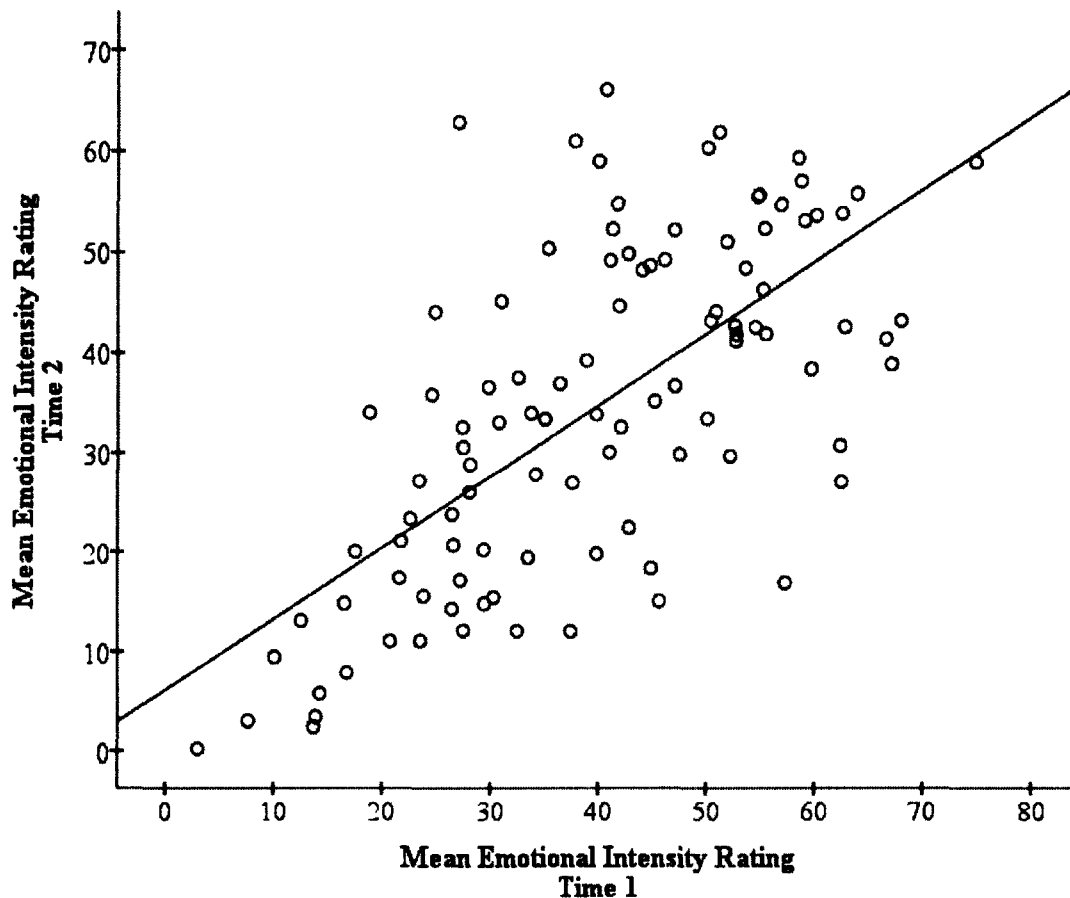


Figure 4. Mean participant ratings (comprising positive and negative stimuli).

Hypothesis 2. Alexithymia¹ will be associated with diminished accuracy in self-perception of FEE.

Correlations

Hypothesis 2 was examined by first calculating the Pearson r correlation between T1 and T2 emotional *intensity* and *valence* ratings for each individual participant. These r values were then themselves correlated with overall TAS-20 scores and scores on TAS components DDF, DIF and EOT. Comparable, more specific analyses were then

¹In the literature, the term “alexithymia” is used categorically, to refer to a clinical condition, and dimensionally, to refer to a normally distributed human trait. It should be understood that in the following text, for ease of exposition, it is the trait concept that is being employed.

performed, correlating TAS-20 and component scores with *intensity* and *valence* ratings separately for positive and negative stimuli. These relationships between individual differences in the accuracy of self-perception of emotional *intensity*, as gauged by correlations between individual participants' T1-T2 *intensity* and *valence* ratings are presented in Table 2. There it can be seen that, while accuracy with respect to *intensity* ratings was not apparently attributable to alexithymia at first glance, when emotional *intensity* ratings were split by *valence* (positive and negative), overall TAS-20 score was negatively correlated with accuracy of *intensity* ratings for negative stimuli.

Individual differences in the accuracy of self-perception of emotional *valence* were negatively correlated with overall TAS-20 scores. In addition, DDF was negatively correlated with accuracy in self-perception of emotional *valence*, as was EOT. When ratings of emotional *valence* were split by positive and negative stimuli, there were no correlations between accuracy in self-perception of positive emotional *valence* and TAS-20 or its subscales. There were, however, significant negative correlations between accuracy of self-perception ratings of negative emotional *valence* and overall TAS-20 scores, as well as specifically for DDF.

Table 2

Pearson r Correlations Between Emotion Accuracy (Measured by Individual Correlations) and TAS-20 Scores

	Accuracy					
	<i>Intensity</i>			<i>Valence</i>		
	All Ratings	Pos. Ratings	Neg. Ratings	All Ratings	Pos. Ratings	Neg. Ratings
SUM	-.163	.018	-.201*	-.235*	-.133	-.199*
DDF	-.140	.077	-.213*	-.233*	-.147	-.263**
DIF	-.076	.031	-.099	-.155	-.107	-.106
EOT	-.184	-.041	-.168	-.199*	-.099	-.150

Note. SUM = overall score on TAS-20, DDF = score on TAS-20 subscale Difficulty Describing Feelings, DIF = score on TAS-20 subscale Difficulty Identifying Feelings, EOT = score on TAS-20 subscale Externally Oriented Thinking.

* $p < .05$. ** $p < .01$.

In light of these significant relationships, stepwise regression analyses were conducted to determine more precisely the role of alexithymia components in mediating accuracy in self-perception of emotion. For each measure of accuracy (overall *valence* and *intensity* rating accuracy, and *valence* and *intensity* rating accuracy split by positivity-negativity of stimuli) as dependent variable, all implicated TAS component scores were entered as predictor variables to determine the unique proportion of variance in accuracy accounted for by each (see Table 3).

In these stepwise multiple regression analyses, there were no significant predictors for overall accuracy of emotional *intensity* ratings, or for accuracy of *intensity* ratings of positive emotion. DDF was the only significant predictor of individual differences in accuracy for *intensity* ratings of negative stimuli between T1-T2,

accounting for 4.1% of the variance in accuracy.

DDF was also the only significant predictor of overall accuracy for *valence* ratings between T1-T2, accounting for 4.5% of the variance in the overall accuracy correlation. For negative *valence* ratings in particular, DDF accounted for 7.4% of the variance in accuracy for *valence* ratings of negative emotion from T1-T2; DIF contributed to this, the total model explaining 10.3%.

Table 3

Stepwise Regression Analyses Predicting Emotion Accuracy From TAS-20 Component Scores

	Index	Model	Predictor	Adj. R^2	Δ R^2	β	t	p	Model (p)
Int.	Neg. r	1	DDF	.041	.050	-.225	-2.340	-	.021
	Neg. %	1	DDF	.033	.043	-.207	-2.129	-	.036
	Slope Overall	1	EOT	.036	.046	-.214	-2.202	-	.030
	Slope Neg.	1	DDF	.040	.050	-.223	-2.300	-	.024
Val.	Overall r	1	DDF	.045	.054	-.233	-2.408	-	.018
	Neg. r	1	DDF	.074	.083	-.288	-3.038	-	.003
		2	DDF	.074	.083	-.532	-3.534	.001	
			DIF	.103	.037	.311	2.065	.041	.002
	Overall %	1	EOT	.037	.046	-.215	-2.215	-	.029
	Neg. %	1	DDF	.030	.039	-.198	-2.027	-	.045
	Slope Overall	1	DDF	.037	.046	-.214	-2.217	-	.029
	Slope Neg.	1	DDF	.075	.084	-.291	-3.052	-	.003
		2	DDF	.075	.084	-.587	-3.931	.000	
			DIF	.122	.055	.378	2.532	.013	.001

Note. Int. = ratings of emotional intensity; Val. = ratings of emotional valence; Neg. r = accuracy as per correlation between ratings of negative stimuli; Neg. % = accuracy as per percent accuracy between ratings of negative stimuli; Slope Neg. = accuracy as per slope of regression line of T1-T2 ratings of negative stimuli; DDF = score on TAS-20 subscale Difficulty Describing Feelings, DIF = score on TAS-20 subscale Difficulty Identifying Feelings, EOT = score on TAS-20 subscale Externally Oriented Thinking.

Percent Accuracy

Individual accuracy in self-perception of emotional *valence* and *intensity* from T1-T2 was also calculated, using percent accuracy measures as described above for each participant. In order to detect relationships between alexithymia and accuracy, Pearson *r* correlations were calculated between percent accuracy measures and overall TAS-20 score as well as scores on the components DDF, DIF and EOT.

These correlation analyses were then conducted at a more specific level, correlating overall TAS-20 score and component scores with *intensity* and *valence* percent accuracy scores separately for positive and negative stimuli. Resultant data regarding relationships between individual differences in the accuracy of self-perception of emotional *intensity* and alexithymia (and its components) are presented in Table 4. Here it is shown that though accuracy with respect to *intensity* ratings was not related to overall TAS-20 score or component scores on an overall level, relationships become apparent when emotional *intensity* ratings are split by *valence* (positive and negative).

Table 4

Pearson r Correlations Between Emotion Accuracy (Measured by Individual Percent Accuracy) and TAS-20 Scores

TAS	Accuracy					
	Intensity			Valence		
	All Ratings	Pos. Ratings	Neg. Ratings	All Ratings	Pos. Ratings	Neg. Ratings
SUM	-.080	.051	-.220*	-.190	-.123	-.181
DDF	-.072	.047	-.207*	-.122	-.015	-.198*
DIF	-.059	-.072	-.204*	-.102	-.082	-.101
EOT	-.053	-.010	-.094	-.215*	-.162	-.158

Note. SUM = overall score on TAS-20, DDF = score on TAS-20 subscale Difficulty Describing Feelings, DIF = score on TAS-20 subscale Difficulty Identifying Feelings, EOT = score on TAS-20 subscale Externally Oriented Thinking.

* $p < .05$. ** $p < .01$.

Specifically, while percent accuracy of *intensity* ratings of positive emotion is not related to TAS-20 or component scores, there are significant negative correlations between individual differences in percent accuracy in *intensity* ratings of negative emotional stimuli and overall TAS-20 score, DDF and DIF. When all TAS-20 components were entered into a stepwise regression, DDF was the only significant predictor of percent accuracy in *intensity* ratings of negative stimuli, accounting for 3.3% of the variance.

Percent accuracy for emotional *valence* ratings was significantly correlated with EOT. Entered into a stepwise regression, EOT was the only significant predictor of overall percent accuracy in *valence* ratings, and accounted for 3.7% of variance.

When ratings of *valence* were split into those for positive and negative stimuli,

there was a negative correlation between DDF and accuracy in negative *valence* ratings.

DDF was also the only significant predictor of percent accuracy of negative *valence* ratings in a stepwise regression, accounting for 3% of the variance.

Slopes

As another accuracy index, the slope of the regression line between T1 ratings and T2 ratings was calculated for each individual, for emotional *intensity* (for both positive and negative stimuli) and for emotional *valence* (for both positive and negative stimuli). This yielded an overall slope value accuracy index for *valence* and *intensity* for each participant, as well as indices of accuracy for *intensity* and *valence* of positive and negative stimuli specifically. To further clarify the relationship between these measures of accuracy and alexithymia, Pearson *r* correlation analyses were then conducted between slope values and TAS-20 overall and component scores (see Table 5).

Table 5

Pearson r Correlations Between Emotion Accuracy (Measured by Slopes of Regression Lines of Ratings from T1-T2) and TAS-20 Scores

	Accuracy					
	Intensity			Valence		
	All Ratings	Pos. Ratings	Neg. Ratings	All Ratings	Pos. Ratings	Neg. Ratings
SUM	-.150	-.004	-.204*	-.192	-.079	-.211*
DDF	-.126	.076	-.223*	-.214*	-.106	-.291**
DIF	-.030	.021	-.077	-.106	-.040	-.082
EOT	-.214*	-.084	-.221*	-.181	-.081	-.178

Note. SUM = overall score on TAS-20, DDF = score on TAS-20 subscale Difficulty Describing Feelings, DIF = score on TAS-20 subscale Difficulty Identifying Feelings, EOT = score on TAS-20 subscale Externally Oriented Thinking.

* $p < .05$. ** $p < .01$.

Slope-assessed accuracy for emotional *intensity* ratings from T1-T2 was negatively correlated only with component EOT scores. However, when split by positive and negative stimuli, TAS-20 overall score, DDF and EOT were negatively associated with accuracy in *intensity* ratings of negative stimuli. Entered into stepwise regression analyses, slope-assessed accuracy in rating overall emotional *intensity* was predicted significantly only by EOT, which accounted for 3.6% of the variance. Once split by *valence*, there were no significant predictors of slope-assessed accuracy in rating *intensity* of positive stimuli. For accuracy in rating *intensity* of negative stimuli, only DDF was a significant predictor, explaining 4% of the variance in accuracy.

Accuracy for all emotional *valence* ratings from T1-T2, as indexed by slope of the regression line, was negatively correlated with the overall TAS-20 score and DDF

component score. When *valence* ratings were broken into positive and negative pairs, there were no correlations between slope-assessed accuracy indices for *valence* of positive emotion and TAS-20 or components. However, negative emotion correlated negatively with overall TAS-20 score, and DDF component score.

Entered into a stepwise regression, DDF was the only significant predictor of slope-assessed accuracy in all *valence* ratings, accounting for 3.7% of the variance. When split into positive and negative stimuli, neither TAS-20 total score nor any component score significantly predicted slope-assessed accuracy in positive *valence* ratings. However, both DDF and DIF were significant predictors of accuracy of emotional *valence* ratings of negative emotion, accounting for 7.5% and 5.5% of the (adjusted) variance, respectively, for a total of 12.2% variance explained.

Hypothesis 3. People will be accurate in perceiving their own pain via facial expression.

Each analysis for the pain portion of the data was run using both the cold pressor task in its entirety (T1), the initial 90 seconds of the cold pressor (T1₉₀), the pain observation task in its entirety (T2) and the ratings of video-clips taken from the first 90 seconds of T1 (T2₉₀). This was done to investigate nuances present in the data due to the characteristic drop and leveling-off of participant pain *intensity* and pain *unpleasantness* ratings after 90 seconds (see Figure 1).

Correlations

Aggregate correlation-based accuracy indices for the pain task are presented in Table 6. In terms of aggregate accuracy correlations, relationships between average T1

and average T2 pain *unpleasantness* ratings (average pain ratings across participants at each 15-second interval of the cold pressor) were significant during the entire task, and during the first 90 seconds of the task. On average, aggregate pain *intensity* ratings for the entire task from T1-T2 were strongly correlated as per established effect size conventions (Cohen, 1988); this relationship was not statistically significant due to small sample size ($n = 12$) when looking at aggregate ratings. However, average *intensity* ratings between T1₉₀ correlated strongly with average T2₉₀ *intensity* ratings. At the aggregate level, then, based on Hypothesis 3, the data are largely consistent (with the exception of pain *intensity* ratings for the overall task) with the expectation that participants would be accurate in perceiving their own experience when observing their facial expressions of pain.

Table 6
Aggregate Pain Accuracy Indices

Rating Stimuli	Pearson <i>r</i> Correlation	
	Intensity	Unpleasantness
All	.528 ^a	.644*
90 Seconds	.921**	.917**

Note. ^a $p = .077$; statistically insignificant due to sample size of averaged ratings ($n = 12$).

* $p < .05$. ** $p < .01$.

Significant, positive intercorrelations were found between average pain *intensity* and average pain *unpleasantness* ratings at all levels of assessment (see Table 7). A series of paired samples *t*-tests was conducted to investigate whether the ratings of these two facets of pain were different from one another. Average ratings of pain *intensity* and *unpleasantness* were significantly different from one another at T1 [$t(107) = -5.406, p <$

.001] and at T2 [$t(98) = -3.747, p < .001$]. The same is true for average ratings of pain *intensity* and *unpleasantness* for the initial 90 seconds; they are significantly different from one another both at T1₉₀ [$t(107) = -6.551, p < .001$] and at T2₉₀ [$t(98) = -.3685, p < .001$]. This in keeping with the assertion that while these two dimensions of pain can vary either separately or together, they appear to be separate and conceptually distinct (Price, Harkins, & Baker, 1987).

Table 7

Intercorrelations Between T1-T2 Average Pain Ratings

		Unpleasantness			
		T1	T1 ₉₀	T2	T2 ₉₀
Intensity	T1	.850**	.839**	.703**	.694**
	T1 ₉₀	.795**	.863**	.665**	.660**
	T2	.603**	.642**	.909**	.891**
	T2 ₉₀	.596**	.642**	.891**	.909**

Note. T1 = Time 1; T1₉₀ = initial 90 seconds of Time 1; T2 = Time 2 (stimuli taken from full task of T2); T2₉₀ = stimuli taken from initial 90 seconds of T1.

* $p < .05$. ** $p < .01$.

Hypothesis 4. Alexithymia will be associated with diminished accuracy in self-perception of pain via facial expression.

Correlations

Hypothesis 4 was examined by first calculating the Pearson r correlation between T1 and T2 pain *intensity* and *unpleasantness* ratings for each participant. These r values

were then correlated with overall TAS-20 scores and scores on TAS components. Similar analyses were performed using individual correlations from the first 90 seconds of T1 and T2 pain tasks. Using individual correlation coefficients as accuracy indices in this way, individual differences in the accuracy of self-perception of pain *intensity* and *unpleasantness* were not statistically associated with alexithymia. This was also the case using accuracy correlations from the first 90 seconds of the task.

Percent Accuracy

Accuracy in self-perception of pain *intensity* and *unpleasantness* as determined by percent of accurate T1-T2 ratings did not relate to alexithymia. This remained so with T1-T2 ratings from the first 90 seconds of the task.

Slopes

Using the slope of the line created by regressing ratings from T1 onto T2 as an accuracy index for each participant, a small correlation was found between accuracy in pain *intensity* ratings and DIF ($r = -.194, p = .054$). In a stepwise regression, no TAS-20 components were significant predictors of accuracy in pain *intensity* ratings. There were no associations between accuracy in *unpleasantness* ratings and TAS-20 or any subscale.

Hypothesis 5. Alexithymia will be associated with a heightened response bias with pain experience and self-observation.

To determine whether TAS-20 overall score or component scores are associated with increased pain ratings during experience and observation, mean ratings of pain *intensity* and *unpleasantness* were calculated for all participants at T1 and T2 (for both

the first 90 seconds and the entire task). These values were entered into correlation analyses to determine relationships between TAS-20 overall and component scores and pain experience (correlation coefficients are presented in Table 8). Significant correlations for pain *intensity* ratings include: T1 average ratings and TAS-20 overall score and DIF, T1₉₀ average ratings and TAS-20 overall score, DIF and DDF, T2 average ratings and TAS-20 overall score, and T2₉₀ average ratings and TAS-20 overall score and DIF. Significant correlations were also found regarding mean pain *unpleasantness* between: T1 average ratings and TAS-20 overall score, T1₉₀ and TAS-20 overall score and DIF.

Table 8

Pearson *r* Correlations Between Mean Pain Ratings and TAS-20 Scores

	Intensity				Unpleasantness			
	T1	T1 ₉₀	T2	T2 ₉₀	T1	T1 ₉₀	T2	T2 ₉₀
SUM	.258**	.269**	.216*	.264**	.214*	.240*	.149	.189
DDF	.167	.193*	.150	.175	.154	.185	.132	.152
DIF	.253**	.247*	.190	.228*	.181	.193*	.102	.136
EOT	.138	.152	.101	.157	.129	.148	.056	.103

Note. SUM = overall score on TAS-20, DDF = score on TAS-20 subscale Difficulty Describing Feelings, DIF = score on TAS-20 subscale Difficulty Identifying Feelings, EOT = score on TAS-20 subscale Externally Oriented Thinking; T1 = Time 1; T1₉₀ = initial 90 seconds of Time 1; T2 = Time 2 (stimuli taken from full task of T2); T2₉₀ = stimuli taken from initial 90 seconds of T1.

* $p < .05$. ** $p < .01$.

Table 9

Stepwise Regression Predicting Mean Ratings by TAS-20 Components

	Mean	Model	Predictor	Adj. R^2	ΔR^2	β	t	p	Model (p)
Int.	T1	1	DIF	.055	.064	.253	2.690	.008	.008
	T1 ₉₀	1	DIF	.052	.061	.247	2.622	.010	.010
Unp.	T1 ₉₀	1	DIF	.028	.037	.193	2.029	.045	.045

Note. Int. = Intensity; Unp. = Unpleasantness; Adj. R^2 = Adjusted R^2 .

In stepwise regression analysis, these findings were clarified as follows: DIF significantly predicted pain *intensity* average ratings at T1, explaining 5.5% of the variance, as well as pain *intensity* average ratings over the first 90 seconds of T1, explaining 5.2% of the variance. DIF also significantly predicted pain *unpleasantness* during the first 90 seconds of T1, accounting for 2.8% of the variance.

Analysis of tolerance (time elapsed until pain threshold was reached or the maximum cold pressor time had elapsed) was also completed; TAS-20 and subscales did not correlate significantly with tolerance.

In order to further test response bias in ratings of experienced and observed pain, individual y -intercept values were calculated for participants corresponding to ratings during: T1, T1₉₀, T2, and T2₉₀. Additional sets of y -intercepts were calculated using the regression line of each participant's ratings from T1-T2 and T1₉₀-T2₉₀.

These values were entered into correlation analyses to determine relationships

between T1 and T2 *y*-intercept values, relationships with TAS-20 overall and component scores, and finally, used as outcome variables in linear regression analyses with TAS-20 overall and component scores as predictors.

Y-intercept values for *intensity* ratings from T1 were significantly correlated with those from T2, both for the overall pain task ($r = .581, p < .001$) and the first 90 seconds ($r = .461, p < .001$). *Y*-intercept values for *unpleasantness* ratings from T1 were also significantly correlated with those from T2, both for the overall pain task ($r = .605, p < .001$) and for the first 90 seconds ($r = .518, p < .001$).

Several significant correlations were found between TAS-20 overall and component scores and the various *y*-intercepts (see Table 10 for coefficients). At Time 1, overall TAS-20 score, DDF, and DIF were significantly associated with *y*-intercept values for *intensity*; at T1₉₀, overall TAS-20 score and DIF were also significantly correlated with *y*-intercept values for *intensity*. Only overall TAS-20 score was significantly correlated with *unpleasantness y*-intercept values at T1; no correlations were found with *unpleasantness y*-intercept values at T1₉₀.

At T2, overall TAS-20 score, DIF and EOT were associated with *y*-intercept values for *intensity* ratings; neither overall TAS-20 score nor component scores correlated with *intensity y*-intercepts for T2₉₀. Only overall TAS-20 score was significantly associated with *unpleasantness y*-intercept values at T2; no correlations were found with *unpleasantness y*-intercept values at T2₉₀.

Table 10

Correlations Between *y*-intercepts of Pain Ratings and TAS-20 Scores

	<i>y</i> -intercept							
	Intensity				Unpleasantness			
	T1	T1 ₉₀	T2	T2 ₉₀	T1	T1 ₉₀	T2	T2 ₉₀
SUM	.267**	.232*	.279**	.185	.220*	.185	.200*	.125
DDF	.197*	.179	.171	.095	.173	.150	.140	.067
DIF	.232*	.218*	.238*	.148	.172	.147	.150	.072
EOT	.172	.125	.197*	.137	.137	.100	.136	.115

Note. SUM = overall score on TAS-20, DDF = score on TAS-20 subscale Difficulty Describing Feelings, DIF = score on TAS-20 subscale Difficulty Identifying Feelings, EOT = score on TAS-20 subscale Externally Oriented Thinking; T1 = Time 1; T1₉₀ = initial 90 seconds of Time 1; T2 = Time 2 (stimuli taken from full task of T2); T2₉₀ = stimuli taken from initial 90 seconds of T1.

* $p < .05$

** $p < .01$

For the *y*-intercept values of regression lines of rating accuracy from T1 - T2, significant correlations were found between DIF and the *y*-intercept of pain *intensity* accuracy regression lines ($r = .197, p = .050$), and approached significance between DIF and *y*-intercept of pain *unpleasantness* accuracy regression lines ($r = .191, p = .058$). No correlations were found between overall TAS-20 or component scores and accuracy regression lines for either *intensity* or *unpleasantness* during the first 90 seconds of the task.

Regression

Stepwise regression analyses were conducted to determine whether TAS-20 overall and component scores were significantly predictive of *y*-intercept values for

ratings of pain *intensity* and *unpleasantness*. All relevant data is included in Table 11; only statistically significant findings are included. DIF explained 4.5% of the variance in y-intercept values for pain *intensity* at T1. DIF also accounted for 3.8% of the variance in pain y-intercept values for pain *intensity* at T1₉₀, and 4.7% of the variance in y-intercept values for pain *intensity* ratings at T2.

Table 11

Stepwise Regression Analysis Predicting y-intercept of Pain *Intensity* Ratings from TAS-20 Scores

y-intercept								
	Model	Predictor	Adj. R^2	ΔR^2	β	t	p	Model (p)
T1	1	DIF	.045	.054	.232	2.444	.016	.016
T1 ₉₀	1	DIF	.038	.047	.218	2.285	.024	.024
T2	1	DIF	.047	.057	.238	2.411	.018	.018

Note. DIF = score on Difficulty Identifying Feelings subscale of TAS-20; T1 = Time 1;

T1₉₀ = initial 90 seconds of Time 1; T2 = Time 2.

Hypothesis 6. Alexithymia will be associated with an emotional response bias, causing lower experienced and self-observed emotion ratings.

To determine whether TAS-20 overall score or component scores are associated with emotion ratings during experience and observation, mean ratings of emotional *intensity* and *valence* were calculated for all participants at T1 and T2 (for both the positive and negative stimuli). Pearson r correlations were then conducted between these values and TAS-20 overall and component scores. Participant mean ratings for emotional *intensity* and *valence* did not correlate with TAS-20 overall or component scores at either

T1 or T2. This held true when the data was split by *valence* (positively *valenced* and negatively *valenced* rating averages).

To further investigate whether alexithymia influences the overall tendency to apply higher or lower numbers when rating emotional *intensity* and *valence*, individual *y*-intercept values were calculated for participants corresponding to ratings during T1 and T2, for overall ratings as well as ratings of positive and negative stimuli specifically. These *y*-intercept values were calculated by using the regression line created by regressing participant ratings (as *y* values) over the 25 time points at which participants made ratings (as *x* values). The *y*-intercept of accuracy (regression of T2 over T1 ratings) was also calculated for each participant.

These values were entered into correlation analyses to determine relationships between T1 and T2 *y*-intercept values, relationships with TAS-20 overall and component scores, and finally, used as outcome variables in linear regression analyses with TAS-20 overall and component scores as predictors (regression statistics are provided in Table 12).

For T1 ratings of emotional *intensity* and *valence*, TAS-20 overall and component scores were not correlated with individual differences in *y*-intercept. In other words, alexithymia did not mediate the tendency to use higher or lower numbers when rating emotionally loaded pictures in general. The same is true for T2; in other words, alexithymia did not contribute to an over or under-estimation bias in overall emotional self-perception.

However, when the data was split by *valence* (positive vs. negative stimuli), there was a significant positive correlation between DDF and the *y*-intercepts of *valence* ratings

of negative facial expressions at T2 ($r = .216, p = .028$). When y -intercepts for emotional *valence* ratings of negative facial expressions at T2 were entered into stepwise regression analyses with TAS-20 components as predictors, DDF explained 3.7% of the variance.

There was a significant positive correlation between individual y -intercepts of the emotional *valence* (including positive and negative emotion) ratings regression lines from T1-T2 (as an accuracy index) and DDF ($r = .211, p = .032$). Specifically, while there were no significant relationships between TAS-20 overall or component scores and y -intercepts of regression lines of *valence* ratings of positive stimuli from T1-T2, there was a significant correlation between DDF and y -intercepts of regression lines of *valence* ratings of negative stimuli from T1-T2 ($r = .264, p = .007$).

When y -intercepts were entered into stepwise regression using component scores as predictor variables, DDF accounted for 3.5% of variance in y -intercept values for *valence* ratings from T1-T2. For y -intercepts of regression lines for accuracy in emotional *valence* ratings of negative stimuli in particular, DDF accounted for 6.1% of the variance, while DIF added another 4% variance accounted for, for a total in the model of 9.2% adjusted variance accounted for.

Table 12

Stepwise Regression Predicting y -intercept of Emotion Ratings From TAS-20 Scores

	y - intercept	Model	Predictor	Adj. R^2	ΔR^2	β	t	p	Model (p)
<i>Valence</i>	Neg. T2	1	DDF	.047	.037	.216	2.225	.028	.028
	Overall T1-T2	1	DDF	.035	.045	.211	2.170	.032	.032
	Neg. T1-T2	1	DDF	.061	.070	.264	2.755	.007	.007
		2	DDF	.061	.070	.517	3.406	.001	
			DIF	.092	.040	-.323	-2.124	.036	.003

Note. DDF = Score on Difficulty Describing Feelings subscale of TAS-20; DIF = Score on Difficulty Identifying Feelings subscale of TAS-20; Neg. T2 = ratings of negative stimuli at T2; Overall = all ratings from T1-T2; Neg. T1-T2 = ratings of negative stimuli from T1-T2; Adj. R^2 = Adjusted R^2 .

Discussion

While the results of this study are consistent and structurally supported by comprehensive analysis, correlations between TAS-20 and its components and examined variables are admittedly all within the small-moderate range. Though at first glance these coefficients are not impressive, they are neither surprising nor indicative of a non-effect when taken in the context of psychology and health research – areas in which small effect sizes are not at all uncommon and often carry important implications (Rosenthal, 1990). Information gathered in this study follows distinct and intriguing patterns, offering insight into discrete effects of components of alexithymia on the experience, expression and self-perception of both emotion and pain. This study supports the notion that, in

general, people are accurate in the self-perception of their own emotional experience via observation of their own facial expressions. It also serves to determine the presence and extent of a relationship between alexithymia and individual differences in the accuracy of self-perception of emotion. Specifically, neither high scores on overall alexithymia or components of the trait are associated with differences in the subjective experience of positive emotion, or in the accuracy of self-observed perception of positive emotion. This is not the case for negative emotion, which it seems is differentially processed by individuals scoring high in certain components of the alexithymic trait. Data suggest that for individuals high in difficulty describing feelings (and to a lesser but additive extent, difficulty identifying feelings), while negative emotional stimuli is not subjectively experienced as more or less negative, both the *intensity* and *valence* of negative emotion is less accurately judged via self-perception of facial expressions of emotion. Also, there is a tendency to judge negative emotion as *less negative* during a self-observation rating task.

This study also provides evidence for the hypothesis that people are accurate in the self-perception of their own pain experience via self-observed facial expression. Contrary to expectation, the presence of alexithymia is not associated with decreased accuracy in self-perception of pain. This finding itself serves to highlight dissimilarity between negative emotion and pain—namely, that while deficits in the self-perception of negative emotion via self-observed facial expression are associated with alexithymia, the same cannot be said for pain. This is not to say that alexithymia is not associated, in this study, with any individual differences in the processing of pain in general. In fact, the

alexithymia component difficulty identifying feelings is associated with an increase in the subjective experience of both pain *intensity*, and, to a lesser extent, pain *unpleasantness*.

It is important to note the distinct pattern of findings in this study with regard to the TAS-20 subscales measuring difficulty *describing* vs. *identifying* emotion. Though the traits these two subscales measure do seem to share a mechanism of effect in some cases within the data, a pattern emerges implicating high levels of difficulty describing feelings in deficits in self-perception of negative emotion, and separately implicating high levels of difficulty identifying feelings in increased subjective experience of pain *intensity* and associated issues. These patterns are explored in detail in as follows.

Evidence from this study supports Hypothesis 1, that participants would be accurate in the self-perception of their own emotion via facial expression. Participants are generally accurate as assessed by several measures of accuracy in judging emotional *intensity* and *valence*. This finding is a significant advance in the investigation of self-perception of emotion —namely, that people are quite accurate in making judgments of their reaction to emotional stimuli based only on the information encoded in their own spontaneous facial expressions. A previous investigation of self-perception via facial expression revealed similar findings regarding accuracy in self-perception, though stimuli in that study were limited to positively *valenced* photographs (i.e. cute animals, decorative paintings and attractive people) and concerned with the detection not of emotional experience but of personal preference (North, Todorov & Osherson, 2012). The current study is the first of its kind in that self-perception judgments were made of both positive and negative standardized emotional stimuli, and included ratings of both

valence and *intensity*. It is also the first of its kind to examine the self-perception of pain experience via facial expression.

Following demonstration of general accuracy in the self-perception of *intensity* and *valence* of both positive and negative emotion, it was possible to investigate individual differences present in accuracy. In effect, this allowed for determination of whether alexithymia, a construct generally accepted to be contingent upon deficits in self-perception of emotion, is actually associated with individual differences in what seems to be a common ability.

As predicted in Hypothesis 2, alexithymia is associated with significant deficits in self-perception of both emotional *intensity* and *valence*, specifically with regard to negative emotion. In fact, this is the case without exception: neither overall alexithymia score nor scores on any component of the alexithymia measure is associated with differences in the accurate perception of positive emotion. This finding is in keeping with previous research on the association between alexithymia and deficits in spontaneous display of negative facial affect (McDonald & Prkachin, 1990), detection of negative facial emotion in others (Prkachin et al., 2009) and reduced ability to nonverbally communicate negative emotion (Wagner & Lee, 2008).

The only significant association with decreased accuracy in self-perception of emotional *intensity* overall (including positive and negative emotion) and alexithymic traits is with the subscale of externally oriented thinking, which predicts 3.6% of variance. This association is only present using one accuracy index (slope of the regression line from T1-T2) as an accuracy index. It is also somewhat clarified by the presence of a negative correlation between externally-oriented thinking and negative

emotional *intensity* ratings only, and the absence of the same for positive emotional *intensity* ratings. This is discussed at more length later on.

When the data are split according to the *valence* of the affectively provocative stimuli used in the emotion task, a specific and recurrent pattern of accuracy deficits for emotional *intensity* is present across all analyses. Decreased accuracy in the self-perception of *intensity* of negative emotion is associated with overall alexithymia score and specifically with difficulty describing feelings for all analyses. The self-perceived *intensity* of negative emotions is significantly related to other components of alexithymia with less consistency. Entering each accuracy index as an outcome variable in stepwise regression, difficulty describing feelings is the sole significant predictor of decreased accuracy in self-perception of negative emotional *intensity* in all cases, accounting for between 3.3 - 4.1% of variance in accuracy.

Decreased accuracy in overall self-perception of emotional *valence* (including positive and negative emotion) is associated with an increase in overall TAS-20 scores as well as scores on the difficulty describing feelings and externally oriented thinking components of the scale. While the trait of externally-oriented thinking is associated with decreased overall accuracy in the self-perception of emotional *valence* in individual correlation and percent accuracy indices (explaining 3.7% of the variance in percent accuracy), difficulty describing feelings is once again implicated in all analyses, solely accounting for between 3.7 - 4.5% of the variance in individual correlation and slope accuracy indices of overall accuracy in self-perception of emotional *valence*.

Once again, when split into positive and negative emotion, a pattern of relationship is established between difficulty describing feelings in particular and

decreased accuracy in self-perception of negative emotion. Difficulty identifying feelings is also implicated, though with less consistency. Accuracy in judgment of the *valence* of negative emotion is negatively associated with difficulty describing feelings for all analyses, accounting for between 3 - 7.4% of the variance on its own, and for between 10.3 - 12.2% when combined with difficulty identifying feelings.

These findings support the notion that alexithymia acts as a mediator of accuracy in the self-perception of emotion, while providing insight into particular mechanisms of deficit. Without exception, the alexithymic trait difficulty describing feelings is associated with decreased accuracy in the self-perception of negative emotion, both for *intensity* and *valence*. As might be expected, difficulty identifying feelings is also implicated in decreased ability to perceive one's own negative emotion, though at no point does it supersede difficulty describing feelings in explanation of variance in accuracy. The cumulative explanation of variance accomplished by difficulty describing and difficulty identifying feelings is impressive: at over 12%, these components of alexithymia are exerting a distinct influence on the ability to accurately perceive the *valence* of one's own negative emotion.

Of note are the somewhat idiosyncratic findings involving the relationship between accuracy in self-perception of overall *intensity* and *unpleasantness* and the trait of externally-oriented thinking. This trait is significantly but inconsistently associated with overall accuracy (comprising positive and negative emotion) in self-perception of emotional *intensity* (predicting 3.6% of variance in slope-assessed accuracy) and *valence* (associated with overall correlational accuracy of ratings at $r = -.199$ and with overall percent accuracy at $r = -.215$ and predicting 3.7% of overall percentage accuracy), though

it ceases to be meaningfully so when the data are split by positive and negative stimuli. Indeed, the only remaining associations between externally oriented thinking and self-perceptual accuracy once the data is split are with negative emotion (associated with negative *intensity* ratings at $r = -.221$), though the trait is not significantly predictive at that level. It seems that when all emotional data is used, externally oriented thinking is associated with enough extra variance in accuracy to achieve significance. It is possible that the trait of externally-oriented thinking is subtly but insignificantly associated with accuracy in both self-perception of positive and negative emotion, and the additive effect creates a detectable, though unstable association.

Results of the current study challenge the presence of a relationship between alexithymia and individual differences in the ability to accurately perceive one's own positive emotion. While it may be premature to state that alexithymia is not a disorder of positive emotion, these results, taken together with previously determined patterns of deficit specific to negative emotion (McDonald & Prkachin, 1990; Wagner & Lee, 2008; Prkachin, Casey & Prkachin, 2009) suggest that alexithymia is not a disorder of self-perception with regard to spontaneous, dynamic positive emotion.

Evidence gathered in this study also support Hypothesis 3: that people would be accurate in the perception of their own facial pain expression. When making judgments via facial expression, participants are exceptionally accurate, on average, in the self-perception of the pain they have experienced during the initial 90 seconds of the task. Participants are considerably less accurate, on average, when they are asked to judge video-clips of their facial expressions of pain taken from the entire cold pressor task. This is almost certainly due to the nature of the pain experience of the cold pressor – as can be

seen in Figure 1, participants' ratings of the sensory and affective dimensions of their pain experience level and begin to decline around the 90-second mark. Anecdotal evidence gathered through speaking with participants after the task also indicates that, for the majority of participants, the experience becomes less stimulating at this time. It stands to reason, therefore, that if, indeed, the pain reaction stabilizes or begins to diminish, participants would be less facially expressive of their pain after this mark, and thus less able to detect it in the self-perception task at T2. This is in accordance with previous research using the Facial Action Coding System to quantify facial behaviour during the cold pressor task, which indicates that pain-related expressions tend to occur most reliably earlier, rather than later in the task (Craig & Patrick, 1985).

It is noteworthy that participants, on average, are equally accurate in their self-perception of the sensory and affective qualities of pain. Analyses of interrelatedness between these components of pain in the current study indicate that while ratings of sensory and affective pain relate very strongly to one another, they are nevertheless distinct from one another.

Contrary to Hypothesis 4 (alexithymia would be associated with decreased accuracy in self-perception of pain), alexithymia is not significantly associated with decreased accuracy in self-perception of either pain *intensity* or *unpleasantness*. It was expected that, given the parallels between negative affect and pain, similar deficits in self-perception would emerge for both. As no evidence for this is provided in this study, utilizing the same paradigm and the same participants for investigation of emotion (including negative affect specifically) and pain, it seems likely that negative affect and

pain perceptual and expressive systems are not as closely linked as the literature and conjecture suggest.

Data gathered in this study are somewhat, though not entirely, consistent with the expectation outlined in Hypothesis 5: that higher alexithymia scores would be associated with higher ratings of pain during subjective experience and observed response tasks. Most notably, higher average ratings of pain *intensity* during the subjective experience (cold pressor) pain task are clearly related to alexithymia, as can be seen in Figure 5.

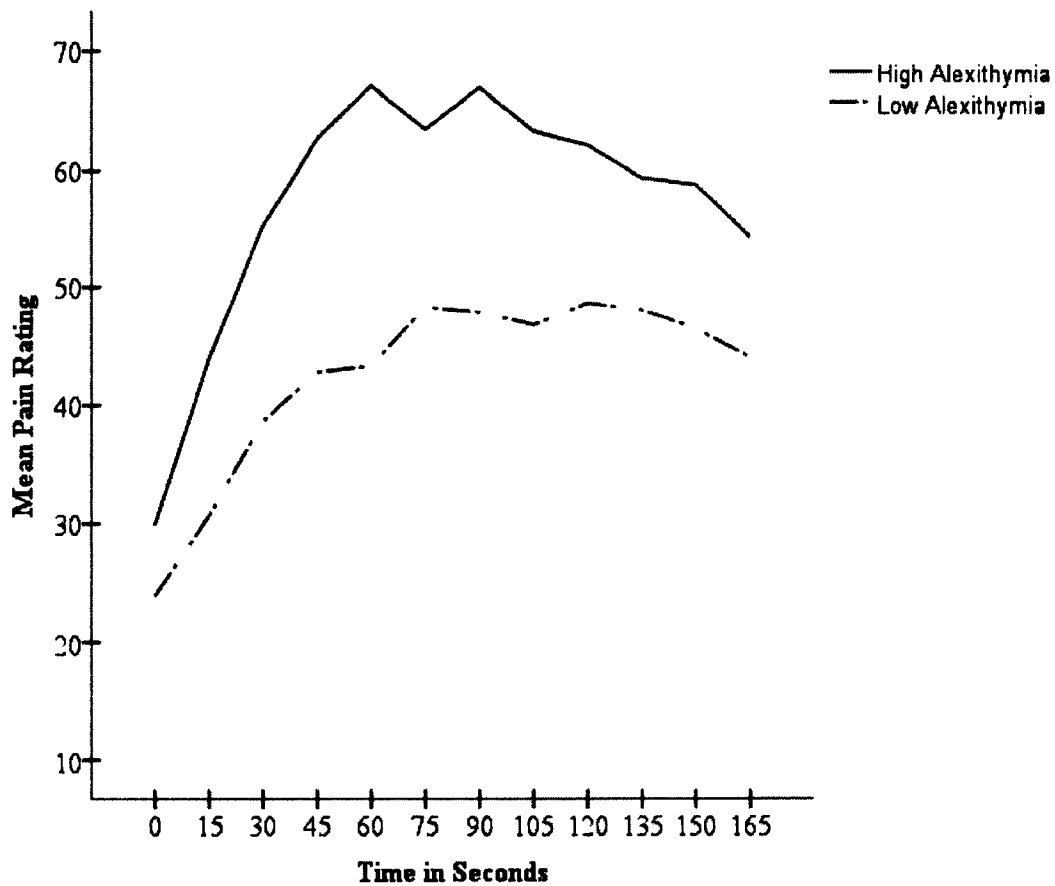


Figure 5. Mean intensity ratings across all time points in cold pressor task.

This is particularly true for the component difficulty identifying feelings. Average cold pressor pain *intensity* ratings during the entire task are related to overall alexithymia score, and specifically to difficulty identifying feelings, which explains 5.5% of the variance therein. When only the first 90 seconds of the cold pressor task are taken into consideration, average pain *intensity* ratings are associated with overall alexithymia score, and with both difficulty describing and identifying feelings, though only the latter explains a significant portion of the variance (5.2%).

While alexithymia seems to mediate the magnitude of pain *intensity* ratings during the cold pressor task, the effect is markedly diminished with ratings of pain *unpleasantness*. Though overall alexithymia score is associated with increased pain *unpleasantness* experience during the entire cold pressor, none of the alexithymia components significantly predict *unpleasantness* over the entire task. Difficulty identifying feelings does, however, significantly predict 2.8% of the variance in pain *unpleasantness* ratings during the initial 90 seconds of the cold pressor task.

Patterns of relationships between alexithymia and pain experience, therefore, appear fairly clear. Alexithymia – in particular, difficulty identifying feelings – is clearly associated with increased pain *intensity* ratings, and somewhat less clearly with pain *unpleasantness* ratings, during the cold pressor task. This pattern of findings is not similarly evident during the self-perception, or observed response (T2) pain task. Interestingly, while overall alexithymia and difficulty identifying feelings scores correlate with average ratings of pain *intensity* during the observational pain task (T2), no component scores significantly predict mean pain *intensity* ratings at T2. There are also no significant correlations between alexithymia or component scores and *unpleasantness*

ratings during T2. It seems, therefore, that while alexithymia is in some way associated with both the experience of pain *intensity* and, to a lesser degree, the experience of pain *unpleasantness*, the effect does not extend to the self-perception of pain to the same degree.

There is also no detectable relationship between alexithymia or any of its components and the tendency to terminate the cold pressor task before its completion (three minutes). Based on the present findings, it is interesting that while individuals high in alexithymia apparently experience higher average pain *intensity* and, to some extent, *unpleasantness* during the cold pressor task, they do not appear to be more likely to voluntarily opt out of finishing the task.

As a more sophisticated measure of response bias, the *y*-intercept analysis provides some additional information regarding the nature of the relationship between alexithymic characteristics and the experience and self-perception of pain. These values allow for estimation of participants' general tendencies to rate their experienced and observed pain higher or lower, as a rule. Intercept values for *intensity* ratings during the cold pressor task are positively associated with overall alexithymia score, difficulty describing feelings and difficulty identifying feelings, the latter of which is the sole significant unique predictor in the stepwise regression, accounting for 4.5% of the variance. Overall alexithymia score and difficulty identifying feelings are each correlated with intercept of pain *intensity* ratings during the first 90 seconds of the cold pressor; difficulty identifying feelings accounting for 3.8% of the variance.

In terms of the intercepts for *unpleasantness* ratings during the cold pressor task, overall alexithymia score is related to the *y*-intercept for the entire task, but no

components of the TAS-20 significantly predict any variance therein. In addition, there are no relationships between intercepts of pain *unpleasantness* ratings during the first 90 seconds of the cold pressor task.

For the intercepts of self-observed pain *intensity* (T2), there are significant relationships between overall alexithymia score, difficulty identifying feelings and externally oriented thinking. Once again, difficulty identifying feelings is the only significant predictor, accounting for 4.7% of the variance in intercept for self-observed pain *intensity* ratings. There are no significant relationships between alexithymia or component scores and intercept of self-observed pain *intensity* ratings from the first 90 seconds of the cold pressor task. Overall alexithymia score is correlated with intercept values of self-observed pain *unpleasantness*, but no component scores are significantly predictive. There are no significant associations between self-observed pain *unpleasantness* *y*-intercept values and overall or component alexithymia scores. These data corroborate other findings in the study, in that participants high in difficulty identifying feelings experience higher pain *intensity* and *unpleasantness*, and are accurate in the self-perception of both of these components of pain.

Data in this study are partially in support of Hypothesis 6: that alexithymia would be associated with a bias toward lower experienced and self-observed ratings of emotion. Contrary to expectation, overall alexithymia and component scores are unrelated to average ratings of emotional *intensity* and *valence* during subjective experience and self-observation tasks, and remain unrelated when the data are split by positive and negative emotional stimuli. Though mean emotion ratings are statistically not different from those not scoring high on alexithymia or component scales, analysis of *y*-intercept values was

undertaken as a more sophisticated measure of whether participants with high alexithymia scores tend characteristically to rate their experience or self-expression of emotional *valence* or *intensity* at a higher or lower level. This examination of response bias yields specific information. Overall alexithymia and component scores do not relate to differences in *y*-intercept for *intensity* of emotional ratings at either T1 or T2, for either positive or negative emotion. In other words, alexithymia does not appear to mediate the tendency to apply higher or lower numbers when rating *intensity* of emotion either during the experience of or the self-observation of emotion in general.

Alexithymia also does not relate to the tendency to apply higher or lower numbers when rating general *valence* during the experience of emotion. It was found, however, that difficulty describing feelings is related to the tendency to use higher numbers when rating self-observed *valence* of negative emotion: *y*-intercept values of self-observed (T2) *valence* ratings of negative emotion tended to be higher for individuals high in this trait. Difficulty describing feelings explains a statistically significant 3.7% of the variance in self-observed *valence* ratings of negative emotion. Considered in relation to the structure of the rating scale employed for *valence* of emotion, a tendency to make higher ratings of negative emotional *valence* indicates that these individuals are inclined to judge their facial expressions of negative emotion as *less negative* than individuals not high in the trait difficulty describing feelings. This is especially intriguing, given the fact that alexithymia does not appear to relate to the inclination to rate the experienced negative emotion (at T1) as less negative; the difference, therefore, is either in the magnitude of the emotional expression, or in the perception of said expression. Since it is difficulty describing feelings and not identifying feelings that is the sole contributor of variance in

this tendency, I am led to surmise that it is the expression of *valence* of negative emotion that is muted in high scorers.

Difficulty describing feelings also positively correlates with and accounts for a statistically significant amount of variance (3.5%) in the y -intercept values of individual accuracy regression lines (using overall ratings of emotional *valence* from T1-T2). Specifically, difficulty describing feelings is positively associated with higher y -intercepts of the regression lines of *valence* ratings of negative stimuli from T1-T2. Difficulty describing feelings accounts for 6.1% of the variance in these intercept values on its own, and when difficulty identifying feelings is also taken into account, 9.2% of the variance is accounted for.

Interpretation of this relationship between alexithymia components difficulty describing and identifying feelings and the placement of y -intercepts of accuracy regression lines is somewhat complex. From the data supporting previous hypotheses, it is established that individuals high in difficulty describing and identifying feelings are less accurate in their self-perception of negative emotion. In terms of a regression line, accuracy is indicated by the presence of a linear relationship; therefore, it can be assumed that the regression line created using inaccurate T1-T2 ratings would be less than linear. As we know that individuals high in difficulty identifying and describing feelings tend to rate their self-observed expression of negative emotion as higher (or more positive), we can conclude that the source of inaccuracy in these individuals' self-perception originates in this tendency to underrate the negativity of their previously experienced emotion. An accuracy regression line in keeping with the tendency to consistently overrate the *valence* of negative emotion at T2 would appear flat, as opposed to linear. This conceptualization

of a flattened regression line for the accuracy of self-perception judgments of negative emotion, taken together with the previously established relationship between decreased self-perception accuracy and difficulty describing/identifying feelings explains the association between higher y -intercepts in accuracy regression lines for negative emotion.

Previous research findings indicate that individuals with alexithymia are impaired in their ability to perceive and discriminate between facial expressions of emotion in other people, and in the ability to describe and express their own emotions, as discussed earlier in a review of the literature. This study attempts to aid in clarification of whether issues in describing and expressing one's own emotion are due to an actual perceptual deficit in the recognition of one's own emotions and the *intensity* of those emotions, or whether it is a solely communicative problem. While the present study cannot resolve these questions completely, results show that individuals high in the alexithymic trait difficulty describing feelings are, in fact, impaired in the self-perception (via observation of their own facial expression) of their own negative emotion. Specifically, though individuals high in difficulty describing feelings do not seem to differ from others in their subjective experience of emotional stimuli, the source of a large part of their inaccuracy in self-observed judgments of negative emotion can be located in their tendency to rate negative emotion as less negative when viewing it on their own face. It is not possible to say with certainty whether this tendency is due to muted negative emotional facial expressions during the subjective experience of emotional stimuli, or to a perceptual deficit when viewing these expressions. However, given that the deficit is associated with an impaired ability to describe one's own feelings, I am led to speculate that the source of the issue is with the proximal expression of negative emotion. As difficulty describing

feelings is related to deficits in the communication of one's own emotion (measurement of this component on the TAS-20 is accomplished using statements such as "it is difficult for me to find the right words for my feelings," and "people tell me to describe my feelings more), and as facial expression is a salient form of nonverbal emotional communication, it stands to reason that individuals high in this trait would be less expressive of their emotion.

Having said so, it is impossible to state conclusively at this point whether the deficit found in this study with regard to facial self-perception of negative emotion is a problem with diminished facial expressiveness of negative emotion, as hypothesized above, or with an extension to oneself of the characteristic deficit in alexithymic individuals in perception of emotional information encoded in the facial expression of others (McDonald & Prkachin, 1990; Simon, Craig, Miltner & Rainville, 2006; Louth, 1998; Simon, Craig, Gosselin, Belin & Rainville, 2008; Green, Tripp, Sullivan & Davidson, 2009; Gonzalez-Roldan, Martinez-Jauand, Munoz-Garcia, Sitges, Cifre & Montoya, 2011; Lane, Sechrest, Reidel, Weldon, Kaszniak & Schwartz, 1996; Prkachin, Casey & Prkachin, 2009).

Previous research in alexithymia supports this notion of reduced nonverbal expression in individuals high in alexithymia (Troisi, Chiaie, Russo, Russo, Mosco & Pasini, 1996), specifically with regard to negative facial affect such as aggression in an interpersonal setting (Rastig, Brosig, & Beutel, 2005), spontaneous display of negative affect in a laboratory setting (McDonald & Prkachin, 1990), and with the spontaneous display of facial expression of emotion while discussing negative life events (Wagner & Lee, 2008). It has also been found that individuals high in alexithymia report lower

experienced emotion in response to emotionally loaded videos while simultaneously exhibiting higher physiological arousal, indicating that alexithymia may not be a problem with the perception of emotional stimuli or the internal response to emotional stimuli, but with the expression of that response (Luminet et al., 2004).

The pattern of associations between alexithymia and component scores and the experience, expression and perception of pain in this study are distinct, in that while there is no association between alexithymia and decreased accuracy in self-perception of facial pain expression, the alexithymic trait of difficulty identifying feelings is solely implicated in individual differences in the subjective experience of pain. Individuals high in this trait tend to rate the subjective experience of pain as more intense and more unpleasant than other individuals. They do not, however, exhibit an overestimation bias for either pain *intensity* or *unpleasantness* when viewing their own facial expressions. High scores in difficulty identifying feelings represent a deficit in the subjective detection and interpretation of one's own internal state (measurement of this component on the TAS-20 is accomplished using statements such as "I don't know what's going on inside me," and "I have feelings that I can't quite identify").

Participants in this study who rated their subjective experience of pain as more intense and unpleasant were able to accurately decode their facial expressions when asked to make self-perception judgments of their own pain at a later date. It may be that these individuals experience heightened pain *intensity* and *unpleasantness* as a consequence of a deficit in the interpretation of their own internal state – a state which they are then capable of accurately expressing and later perceiving from their own facial expression.

Future research on this topic ought to directly investigate differences in the processing and accuracy of other-perception alongside self-perception. It will also be helpful, in future, to calculate a measure of individual expressiveness as determined by third-person ratings of videos that will be used for the measurement of accuracy in self-perception. In this way, the relationship between differences in accuracy of self-perception of emotion in alexithymia may be made clearer by directly addressing the issue of a possible characteristic lack of expressiveness in the alexithymic individual's video-taped facial expression of negative emotion.

The current study clearly delineates the deficits in emotional self-perception in alexithymia by *valence* – that is, it has been shown that individuals scoring high on the difficulty describing feelings component of the TAS-20 in particular exhibit deficits in self-perception of negatively *valenced* emotion, broadly. Future research may investigate, with this in mind, whether specific negative emotions (e.g. fear, anger or sadness) are implicated in particular.

References

- Buck, R., Miller, R., & Caul, W. (1974). Sex, personality and physiological variables in the communication of affect via facial expression. *Journal of Personality and Social Psychology*, 30(4): 587-596.
- Buck, R. (1979). Measuring individual differences in the nonverbal communication of affect: The slide-viewing paradigm. *Human Communication Research*, 6(1), 47-57.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Psychology Press.
- Craig, K., & Patrick, C. (1985). Facial expression during induced pain. *Journal of personality and social psychology*, 48(4), 1080.
- Gonzalez-Roldan, A., Martinez-Jauand, M., Munoz-Garcia, M., Sitges, C., Cifre, I., & Montoya, P. (2011). Temporal dissociation in the brain processing of pain and anger faces with different intensities of emotional expression. *Pain*, 152: 853-859.
- Green, A., Tripp, D., Sullivan, J., & Davidson, M. (2009). The relationship between empathy and estimates of observed pain. *Pain Medicine*, 10(2): 381-392.
- Hang Li, Y. & Tottenham, M. (2011). Seeing yourself helps you see others. *Emotion*, 11(5): 1235-1241.
- Hosoi, M., Molton, I., Jensen, M., Ehde, D., Amtmann, S., O'Brien, S., Arimura, T., & Kubo, C. (2010). Relationships among alexithymia and pain intensity, pain interference, and vitality in persons with neuromuscular disease: Considering the effect of negative affectivity. *Pain*, 149: 273-277.
- Iafrati, N. (1986). Pain on the burn unit: Patient vs. nurse perceptions. *Journal of Burn*

Care and Rehabilitation, 7: 413–416.

Jackson, T., Nagasaka, T., Fritch, A., & Gunderson, J. (2002). Alexithymia is not related to tolerance for cold pressor pain. *Perceptual and Motor Skills*, 94: 487-488.

Jensen, M., & Karoly, P. (2011). Self-report scales and procedures for assessing pain in adults. In D. Turk & R. Melzack (Eds.), *Handbook of Pain Assessment: 3rd Edition* (pp. 19 – 44). NY, New York: The Guilford Press.

Kano, M., Hamaguchi, T., Itoh, M., Yanai, K., & Fukudo, S. (2007). Correlation between alexithymia and hypersensitivity to visceral stimulation in humans. *Pain*, 132: 252-263.

Katz, J., Martin, A., Pag, M., & Calleri, V. (2009). Alexithymia and fear of pain independently predict heat pain intensity ratings among undergraduate university students. *The Journal of the Canadian Pain Society*, 14(4): 299-305.

Kooiman, C., Spinhoven, P., & Trijsburg, R. (2002). The assessment of alexithymia: A critical review of the literature and a psychometric study of the Toronto Alexithymia Scale-20. *Journal of Psychosomatic Research*, 53: 1083-1090.

Kunz, M., Lautenbacher, S., LeBlanc, N., & Rainville, P. (2012). Are both the sensory and the affective dimensions of pain encoded in the face?. *Pain*, 153(2), 350-358.

Lane, R., Ahern, G., Schwartz, G., & Kaszniak, A. (1997). Is alexithymia the emotional equivalent of blindsight? *Biological Psychiatry*, 42: 834-844.

Lane, R., Quinlan, D., Schwartz, G., Walker, P., & Zeitlin, S. (1990). The Levels of Emotional Awareness Scale: a cognitive-developmental measure of emotion. *Journal of Personality Assessment*, 55(1-2): 124-134.

- Lane, R., Sechrest, L., Reidel, R., Weldon, V., Kaszniak, A., & Scwhartz, G. (1996).
Impaired verbal and nonverbal emotion recognition in alexithymia.
Psychosomatic Medicine, 58: 203 – 210.
- Lang, P., Bradley, M., & Cuthbert, B. (2005). *International affective picture system (IAPS): Affective ratings of pictures and instruction manual*. NIMH, Center for the Study of Emotion & Attention.
- Lang, P., & Bradley, M. (2007). The International Affective Picture System (IAPS) in the study of emotion and attention. *Handbook of emotion elicitation and assessment*, 29.
- Larsen, J., Brand, N., Bermond, B., & Hijman, R. (2003). Cognitive and emotional characteristics of alexithymia: A review of neurobiological studies. *Journal of Psychosomatic Research*, 54(6): 533 – 541.
- Loas, G., Corcos, M., Stephan, P., Pellet, J., Bizouard, P., Venisse, J. L., Perez-Diaz, F., Guelfi, J., & Jeammet, P. (2001). Factorial structure of the 20-item Toronto Alexithymia Scale: confirmatory factorial analyses in nonclinical and clinical samples. *Journal of Psychosomatic Research*, 50(5), 255-261.
- Luminet, O., Rime, B., Bagby, R., & Taylor, G. (2004). A multimodal investigation of emotional responding in alexithymia. *Cognition and Emotion*, 18(5): 741-766.
- Lumley, M., Radcliffe, A., Macklem, D., Mosley-Williams, A., Leisen, J., Huffman, J., D'Souza, P., Gillis, M., Meyer, T., Kraft, C., & Rapport, L. (2005). Alexithymia and pain in three chronic pain samples: Comparing Caucasians and African Americans. *Pain Medicine*, 6(3): 251-261.

- McDonald, P., & Prkachin, K. (1990). The expression and perception of facial emotion in Alexithymia: A pilot study. *Psychosomatic Medicine* (52): 199-210.
- Meganck, R., Vanheule, S., & Desmet, M. (2008). Factorial validity and measurement invariance of the 20-item Toronto Alexithymia Scale in clinical and nonclinical samples. *Assessment*, 15(1), 36-47.
- Mitchell, L., MacDonald, R., & Brodie, E. (2004). Temperature and the cold pressor test. *The Journal of Pain*, 5(4): 233-238.
- Moriguchi, Y., Decety, J., Ohnishi, T., Maeda, M., Mori, T., Nemoto, K., Matsuda, H., & Komaki, G. (2007). Empathy and judging other's pain: An fMRI study of alexithymia. *Cerebral Cortex*, 17: 2223-2234.
- Naatanen, P., Ryyanen, A., & Keltikangas-Jarvinen, L. (1999). The influence of alexithymic characteristics on the self-perception and facial expression of a physiological stress state. *Psychotherapy and Psychosomatics*, 68(5): 252-262.
- North, M., Todorov, A., & Osherson, D. (2012). Accuracy of inferring self- and other-preferences from spontaneous facial expressions. *Journal of Nonverbal Behavior*, 36(4), 227-233.
- Nyklicek, I., & Vingerhoets, A. (2000). Alexithymia is associated with low tolerance to experimental painful stimulation. *Pain*, 85: 471-475.
- Parker, J., Bagby, M., Taylor, G., Endler, N., & Schmitz, P. (1993). Factorial validity of the 20-item Toronto Alexithymia Scale. *European Journal of Personality*, 7(4), 221-232.
- Price, D., Harkins, S., & Baker, C. (1987). Sensory-affective relationships among different types of clinical and experimental pain. *Pain*, 28(3), 297-307.

- Prkachin, G., Casey, K., & Prkachin, K. (2009). Alexithymia and perception of facial expressions of emotion. *Personality and Individual Differences*, 46: 412-417.
- Rasting M., Brosig, B., & Beutel, M. (2005). Alexithymic characteristics and patient-therapist interaction: A video analysis of facial affect display. *Psychopathology*, 38(3).
- Rosenthal, R. (1990). How are we doing in soft psychology?. *American Psychologist*, 45(6), 775.
- Sifneos, P. (1973). The prevalence of 'alexithymic' characteristics in psychosomatic patients. *Psychotherapy and Psychosomatics*, 22(2-6): 255-262.
- Simon, D., Craig, K., Gosselin, F., Belin, P., & Rainville, P. (2008). Recognition and discrimination of prototypical dynamic expressions of pain and emotions. *Pain*, 135: 55-64.
- Smith, E. & Zarate, M. (1992). Exemplar based model of social judgment. In N. Ambady, F. Bernieri & J. Richeson (Eds.), *Toward a histology of social behaviour: Judgmental accuracy from thin slices of the behavioural stream* (pp. 254). Academic Press.
- Subic-Wrana, C., Beutel, M., Garfield, D., & Lane, R. (2011). Levels of emotional awareness: A model for conceptualizing and measuring emotion-centered structural change. *The International Journal of Psychoanalysis*, 92: 289-310.
- Taylor, G. (1984). Alexithymia: Concept, measurement, and implications for treatment. *The American Journal Of Psychiatry*, 141(6), 725-732.
- Taylor, G., Bagby, R., & Luminet, O. (2000). Assessment of alexithymia: Self-report and observer-rated measures. *The handbook of emotional intelligence*, 301-319.

- Troisi, A., Chiaie, R., Russo, F., Russo, M., Mosco, C., & Pasini, A. (1996). Nonverbal behavior and alexithymic traits in normal subjects: Individual differences in encoding emotions. *The Journal of Nervous and Mental Disease*, 184(9): 561 – 566.
- Vanman, E., Dawson, M., & Brenman, P. (1998). Affective reactions in the blink of an eye: Individual differences in subjective experience and physiological responses to emotional stimuli. *Personality and Social Psychology Bulletin*, 24, 994 - 1005.
- Wagner, H., & Lee, V. (2008). Alexithymia and individual differences in emotional expression. *Journal of Research in Personality*, 42: 83-95.
- White, K., McDonnell, C., & Gervino, E. (2011). Alexithymia and anxiety sensitivity in patients with non-cardiac chest pain. *Journal of Behavior Therapy and Experimental Psychiatry*, 42: 432-439.
- Wood, R., Maclean, L., & Pallister, I. (2011). Psychological factors contributing to perceptions of pain *intensity* after acute orthopaedic injury. *Injury*, 42: 1214-1218.

Appendix 1

Short-Form LEAS Questionnaire

1. A neighbor asks you to repair a piece of furniture. As the neighbor looks on, you begin hammering the nail but then miss the nail and hit your finger. How would you feel? How would the neighbor feel?
2. A loved one gives you a back rub after you return from a hard day's work. How would you feel? How would your partner feel?
3. As you drive over a suspension bridge you see a person standing on the other side of the guardrail, looking down at the water. How would you feel? How would the person feel?
4. Your boss tells you that your work has been unacceptable and needs to be improved. How would you feel? How would your boss feel?
5. You are standing in line at the bank. The person in front of you steps up to the window and begins a very complicated transaction. How would you feel? How would the person in front of you feel?

Appendix 2

Task Instructions

Pain Expression Task

“During this task, I am going to ask you to put your left hand into this cold water bath. Exposure to cold water is harmless; however, it can be associated with some discomfort or pain, which is absolutely normal and has no further consequences. While your hand is in the water, I would like you to make a set of two pain ratings every fifteen seconds. These ratings will be of two different components of pain, intensity and unpleasantness. The first is easy to distinguish - it is how much the cold water physically hurts your hand and arm. The second type of pain is emotional; it is how much the pain bothers or annoys you. The distinction between these two aspects of pain might be made clearer if you think of listening to music on a radio. As the volume of the music increases, I can ask you how loud it sounds or how unpleasant it is to hear. The intensity of pain is like loudness. The pleasantness or unpleasantness of the music depends on how much you like or dislike the music. The unpleasantness of pain depends on how much you dislike the feeling. Here are examples of each scale (show posters). The bottom range of the first scale represents “no pain at all,” while the top range represents “worst pain imaginable”. To manipulate this scale, you click on the spot on the scale that you feel best represents your sensory pain. The bottom range of the second scale represents “not at all” unpleasant, while the top range represents “the most unpleasant feeling.” You will use this scale in the same way as the first one. Each scale will remain on the screen for ten seconds, or until you make your rating. A “ding” will sound every fifteen seconds to remind you to make a new set of ratings. The task will continue for three minutes. You should try to keep your hand and arm in as long as you can; however, if you feel you cannot endure the full three minutes, you may withdraw your hand and terminate the experiment. Using this monitor, I will observe your hand from the adjoining room. The monitor will transmit video and audio to me, so that I may let you know when to start the task, and you may let me know when you’ve finished. The monitor transmits audio as well as video of your arm in real time; it is not making any recordings. I’m going to go to the other room to calibrate the psychophysiological recording equipment. Please remain still, with your arm resting on the armrest, until three minutes have passed and you hear me say “start.” Then, put your hand in the water, and click anywhere on the screen to begin the task. It is very important that you try to remain as still as possible during the task, as any body movements will interfere with the psychophysiological recording equipment. When the task is over, say “stop,” and we will continue to the next part of the experiment. Do you have any questions?”

Emotional Expression Task

“During this task, I am going to ask you to view 25 pictures on this computer screen. I would also like you to discuss and rate your feelings after each picture. After a picture is

shown for 5 seconds, a bell will sound: this is your signal to begin describing, in words, how the picture makes you feel. You can say anything that comes to mind that describes how you feel about the slide. It is not important what you say, just that you talk about your feelings in some way. After 10 seconds, the picture will disappear, indicating that you can stop describing your feelings. At this time, I would like you to make two ratings for each slide: one for how intense you found the slide, and one for how pleasant or unpleasant you found the slide. You will make these ratings using this scale (show participant VAS example on wall). To manipulate this scale, you just click using the mouse. The bottom ranges of these scales represent “as weak as it could be” or “as unpleasant as it could be,” while the top ranges represent “as strong as it could be” or “as pleasant as it could be”. Please note that a neutral intensity rating would be at the far left of the scale (as weak as it could be), while a neutral pleasantness rating would be in the center of the scale (midway between as unpleasant and as pleasant as it could be). You will have 10 seconds to complete each rating using these scales. After ten seconds, the next slide will come on. You will complete these steps (a verbal description and two ratings) for each of 25 slides. You are free to withdraw from this task at any time if you feel too uncomfortable to continue, with no penalty. Do you have any questions?”

Pain Perception Task

“During this task, I am going to ask you to view an edited version of the video of yourself taken during your first session. This video is about five minutes long, and includes clips of your face when you were experiencing differing amounts of pain during the cold pressor task. What I would like you to do is use the same scales you used in first session to rate the pain you think you were in during each clip, based only on the video of your facial expression. When you rate the intensity of the pain, think of how much it seems your arm was hurting at the time; when you rate the unpleasantness of the pain, think of how much it seems this pain bothered you at the time. This is not a memory test, and the clips are in random order. The idea is to see how good you are at telling how you were feeling in each clip just by looking at your facial expression on video. Each clip will last for five seconds, after which you will have ten seconds to use the scale on the computer screen to rate the pain you think you were in. Do you have any questions?”

Emotional Perception Task

“During this task, I am going to ask you to view an edited version of the video of yourself taken during our first session. This video is about fifteen minutes long, and includes clips of your facial expressions while viewing pictures and describing your feelings about those pictures. What I would like you to do is use the same scale you used in the first session to rate how pleasant (from “as unpleasant” to “as pleasant as it could be”) and how intense (from “as weak” to “as strong as it could be”) you think the slide you were viewing in each clip was, based only on your recorded facial expression. This is not a memory test, and the clips are in random order. The idea of this task is to see how good you are at telling how you were feeling in each clip just by looking at your recorded

facial expression. Each clip will last for fifteen seconds, after which you will have ten seconds to move each scale on the computer screen to rate how intense and how pleasant you think the picture you viewed was. Do you have any questions?"

Third-Person Pain Task

"During this task, I'll ask you to view a video consisting of 60 clips of other people in varying amounts of pain. Following each clip, you will make a set of pain ratings. One rating will be of pain intensity, and the other will be of pain unpleasantness. The first is easy to distinguish - it is how much you believe the pain physically hurts the person in the clip. The second type of pain is emotional; it is how much you think the pain bothers or annoys the person in the clip. Here are examples of each scale (show posters). The bottom range of the first scale represents "no pain at all," while the top range represents "worst pain imaginable". To manipulate this scale, you click on the spot on the scale that you feel best represents the sensory pain of the person in the clip. The bottom range of the second scale represents "not at all" unpleasant, while the top range represents "the most unpleasant feeling." You will use this scale in the same way as the first one."

Appendix 3

IAPS Stimuli List

Slide Number	Description	IAPS Slide Number	IAPS <i>Valence</i> Rating	IAPS <i>Intensity</i> Rating
1.	Spider	1201	3.55	6.36
2.	Cow	1670	5.82	3.33
3.	Puppies	1710	8.34	5.41
4.	Attack	6540	2.19	6.83
5.	Three men	2370	7.14	2.9
6.	Teens	2389	6.61	5.63
7.	Sad girls	2455	2.96	4.46
8.	Couple	2501	6.89	3.09
9.	Harvest	2515	6.09	3.8
10.	Elderly man	2520	4.13	4.22
11.	Couple	2550	7.77	4.68
12.	Male	2630	6.35	3.92
13.	Mutilation	3000	1.59	7.34
14.	Burn victim	3053	1.31	6.91
15.	Erotic couple	4660	7.4	6.58
16.	Shipwreck	9620	2.7	6.11
17.	Basket	7010	4.94	1.76
18.	Shoes	7031	4.52	2.03
19.	Book	7090	5.19	2.61
20.	Hammer	7110	4.55	2.27
21.	Window	7490	5.52	2.42
22.	Puddle	9110	3.76	3.98
23.	Garbage	9340	2.41	5.16
24.	Dead man	9433	1.84	5.89
25.	Dental exam	9584	3.34	4.96

Appendix 4

Toronto Alexithymia Scale (TAS-20)

Using the scale provided as a guide, indicate how much you agree or disagree with each of the following statements by selecting the correct number.

		Strongly Disagree	Moderately Disagree	Neither Disagree Nor Agree	Moderately Agree	Strongly Agree
1.	I am often confused about what emotion I am feeling.	1	2	3	4	5
2.	It is difficult for me to find the right words for my feelings.	1	2	3	4	5
3.	I have physical sensations that even doctors don't understand.	1	2	3	4	5
4.	I am able to describe my feelings easily.	1	2	3	4	5
5.	I prefer to analyze problems rather than just describe them.	1	2	3	4	5
6.	When I am upset, I don't if I am sad, frightened, or angry.	1	2	3	4	5
7.	I am often puzzled by sensations in my body.	1	2	3	4	5
8.	I prefer to just let things happen rather than to understand why they turned out that way.	1	2	3	4	5
9.	I have feelings that I can't quite identify.	1	2	3	4	5
10.	Being in touch with emotions is essential.	1	2	3	4	5
11.	I find it hard to describe how I feel about people.	1	2	3	4	5
12.	People tell me to describe my feelings more.	1	2	3	4	5
13.	I don't know what's going on inside me.	1	2	3	4	5
14.	I often don't know why I'm angry.	1	2	3	4	5
15.	I prefer talking to people about their daily activities rather than their feelings.	1	2	3	4	5
16.	I prefer to watch "light" entertainment shows rather than psychological dramas.	1	2	3	4	5
17.	It is difficult for me to reveal my innermost feelings, even to close friends.	1	2	3	4	5
18.	I can feel close to someone, even in moments of silence.	1	2	3	4	5
19.	I find examination of my feelings useful in solving personal problems.	1	2	3	4	5
20.	Looking for hidden meaning in movies or plays distracts from their enjoyment.	1	2	3	4	5